Credit Creation: The “Good”, the “Bad” and the “Ugly”

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Abstract: This paper develops a stock-flow consistent model to study the effects of three types of bank credit: credit for production, credit for consumption, and credit for asset speculation. The main findings are: (1) Credit for production (the “good”) enables capital formation and the adoption of more productive technologies; (2) Credit for consumption (the “bad”) diverts some real savings from capital formation to consumption, resulting in lower total output and less individual wealth; and (3) Credit for speculation (the “ugly”) funds real wealth transfers that are unrelated to wealth creation. It can result in higher prices in the goods market, which harms all consumers including those who do not participate in asset speculation.

Key Words: stock-flow-consistent model, credit creation, production loans, consumption loans, loans for asset speculation

JEL Code: E12, G21

1. Introduction

Over the last three decades, economists have devoted much research effort to examining what is considered to be one of the most important questions in finance, namely, how finance affects economic development (Levine, 2021). Many studies have identified a positive empirical relationship between financial development and economic growth (Ang, 2008). However, there is also a growing body of evidence suggesting that the relationship is not as robust as once believed and can turn negative in some cases. (Arcand et al., 2015; Cecchetti & Kharroubi, 2012; Rousseau & Wachtel, 2011). How might we reconcile the apparently contradictory findings? The key seems to lie in the recognition that different types of finance may have different effects on economic performance (Bezemer, 2014).

In Chapter 15 of his *Treaties on Money*, Keynes (1930) made a distinction between two types of credit circulation: “industrial” versus “financial”. Industrial circulation concerns credit for the purpose of maintaining the normal process of production, distribution, exchange and factor payments. Financial circulation concerns credit for the purpose of holding and exchanging existing titles to assets, such as stock market transactions and speculation. Schumpeter (1934, 1939) made a similar distinction with different terms: “productive” versus “unproductive” credit. Productive credit funds investment and production. Unproductive credit funds transfers of existing goods or assets. Since industrial or productive credit facilitates capital accumulation, production and innovation, it promotes economic growth. In contrast, financial or unproductive credit can stage a boom-and-bust cycle, disrupting economic development (Schumpeter, 1939).

Once we distinguish the effects of different types of credit creation, the important question changes from “how does finance affect economic development” to “how different finance affects economic development differently”. It is the latter question that we address in this paper. Specifically, we develop a stock-flow consistent model to study how three types of bank credit creation - credit for production, credit for consumption, and credit for speculation - may affect wealth production and distribution differently. An outline of the model is as follows.

In the model economy, individuals have an initial endowment which can be divided into consumption and real savings. The endowment is real resources in the form of a single good. The good can be produced with two different technologies: the home technology which requires only labor, and the more productive factory technology which requires both labor and capital. To carry out factory production, the entrepreneur establishes a firm, but the firm cannot acquire inputs without finance. Finance is provided by a bank which is established by the banker.

At the beginning of a period, the firm borrows from the bank to buy real savings to form capital. The firm’s expenditure is the savers’ revenue which is deposited with the bank. The firm then hires factory workers to start production. At the end of the period, production is completed, the firm again borrows from the bank to make factor payments. The bank also pays depositors and the banker. Once individuals receive their payments, they purchase the firm’s output. With the sales revenue, the firm repays both loans. The loan repayment extinguishes all outstanding credit. Individuals’ purchases become their endowments at the beginning of the next period, and the production cycle repeats. Each cycle begins with loan issuance and ends with loan repayment. The continuation of the production process is enabled by evolving loans.

In the first case of the model, the bank creates credit to finance only productive activities of the firm. The bank credit enables the firm to increase output by adopting the more productive factory technology. As the scale of factory production increases, output growth can continue for some time until a steady state is reached. The increased real wealth due to factory production is distributed to individuals as factor payments, which reflect their contributions to factory production: savers receive deposit interests; workers and managers receive wages; and the banker and the entrepreneur receive equity returns.

In the second case of the model, the bank provides both production credit to the firm and consumption credit to impatient factory workers. The consumption credit allows impatient workers to consume some of the real savings that could have been used for capital formation. As a result, the scale of factory production is reduced and the economy produces less real wealth for all individuals.

In the third case of the model, the bank provides production credit to the firm, and also lends to two speculators to finance their asset purchases. Specifically, speculator 1 obtains credit to purchase the firm from the entrepreneur; and subsequently speculator 2 obtains credit to purchase the same asset from speculator 1. The entrepreneur and speculator 1 receive capital gains from the asset transactions. However, speculator 2 is unable to sell the asset before the end of the period to repay his loan plus interest, so he defaults. In one scenario, the asset held by speculator 2 is valued at the firm's book value, in which case, the speculative transactions result in a simple transfer of real wealth from the loser (the bank) to the winners (the entrepreneur and speculator 1); other individuals are not affected. In another scenario, the asset is valued at speculator 2's purchase price, in which case there is a credit expansion, causing inflation in the goods market. The speculative transactions still generate gains for the entrepreneur and speculator 1, and losses for the bank. However, through higher prices in the goods market, some of the bank's losses are passed on to all money holders.

We refer to credit for production as the "good", credit for consumption as the "bad", and credit for asset speculation as the "ugly". These are shorthand labels based on the effects of these credit types on the production and distribution of the model economy's real wealth. No attempt is made to analyze the welfare effects (in terms of individual utility), and no normative statements are implied by these labels. We also emphasize that in this model the bank creates credit through lending; hence all three types of credit result from credit creation.

Our model follows the stock-flow consistent approach pioneered by Wynne Godley and James Tobin (Godley & Lavoie, 2007). In the model, all transactions are monetary transactions mediated by the bank so that all transactions and their associated money flows are recorded on the bank's balance sheet. This transaction record and the record of individuals' resource positions form the stock and flow matrices, which capture the changing stock of wealth and the events that lead to the changes. Based on the stock and flow matrices, we then write the systems of equations and obtain numerical solutions to quantify the dynamics of the economy.

The setup of our model draws from the money circulation theory of production (Graziani, 2003), particularly the idea that banks create credit by issuing loans, and the loans provide the initial liquidity to start production. When the bank makes a loan to the firm, a deposit is created, and the firm uses the created deposit to acquire real savings and labor inputs. By making profitable loans for productive purposes, the bank allocates real savings and other resources to efficient use.

This paper belongs to the large literature on the nexus of finance and economic development. The existing literature provides many insights into the mechanisms through which credit promotes economic growth. For instance, King & Levine (1993a, 1993b) suggest that financial institutions evaluate and fund entrepreneurial activities so that resources are directed to more promising investment projects. Bencivenga & Smith (1991) show that credit reduces the need for self-financing, which promotes capital formation and growth. Acemoglu and Zilibotti (1997) emphasize the role of financial intermediaries in pooling savings and reducing risks through diversification. Greenwood & Smith (1997) suggest that financial intermediation facilitates trade by lowering transaction costs. The literature also points to some negative impacts of excessive financialization. For example, Rousseau & Wachtel (2011) suggest that excessive credit growth since the 1990s may have weakened the banking system and caused inflation. Cecchetti & Kharroubi (2012) find that a fast-growing financial sector in advanced economies has a negative impact on aggregate productivity growth. Arcand et al. (2015) contend that financial deepening can be detrimental to growth once private debt level exceeds 100% of GDP. Mian and Sufi (2018) show that credit expansion was an important reason behind the housing bubble that resulted in the 2008 financial crisis. Botta et al. (2021) suggest that wealth inequality has influenced the development of modern financial system and the financial system in turn has exacerbated inequality.

This paper contributes to the existing literature by illustrating how “productive” and “unproductive” credit may affect an economy differently. It demonstrates that “productive” credit is indispensable to capitalist production – without credit, capital cannot be formed, inputs cannot be acquired and inventory cannot be maintained. The larger the productive economy, the more credit is required (Beck et al., 2023). In addition, “productive” credit promotes economic growth by facilitating the adoption and expansion of better technologies. In contrast, “unproductive” credit has very different effects on production and distribution. For example, consumption credit can reduce real wealth creation if real savings are the binding constraint of profitable investment. Speculative credit alters wealth distribution without contributing to wealth creation, and may cause higher prices in the goods market that harms all consumers including those who do not participate in speculation.

The remainder of the paper is organized as follows. Section 2 describes the setup of the model. Sections 3, 4 and 5 model the economy in three cases, each with a different type of bank credit: (1) the “good” case in which the bank finances only productive activities; (2) the “bad” case in which consumption loans are introduced; and (3) the “ugly” case in which loans for asset speculation are provided. Section 6 presents numerical solutions of the model and discusses how different types of credit creation affect economic outcomes. Section 7 summarizes the findings and discusses possible extensions of the model.

2. Model setup

2.1. Endowment, technologies and finance

Consider an economy with N individuals who live for an indefinite number of periods. The individuals consume a single good X. Each individual has an endowment of good X at the beginning of period 1, and has 1 unit of labor per period.

Good X can be produced using two different technologies. Production takes one period regardless of the technology used. The home technology requires only labor (l):

$$x_h = al \tag{2.1}$$

The more productive factory technology requires factory workers (N_{FW}), capital goods (K), and one entrepreneurial input (E). The capital good fully depreciates in one period.

$$x_f = \begin{cases} A[min(N_{FW}, K)], & \text{if } E = 1 \\ 0, & \text{if } E < 1 \end{cases} \tag{2.2}$$

This specification assumes that labor and capital are perfect complements: one unit of labor is required to work with one unit of capital good K.

Capital good K can be transformed from good X instantaneously so that factory production can commence in the same period in which capital is formed. The formation of capital requires the same entrepreneurial input as in factory production:

$$K = \begin{cases} bX_k, & \text{if } E = 1,\ X_k > R_{1E} \\ 0, & \text{if } E < 1, \text{or } X_k \leq R_{1E} \end{cases} \tag{2.3}$$

The entrepreneurial input (E) represents the entrepreneur's time and energy devoted to forming capital, hiring workers and organizing production. The entrepreneur must devote all her labor endowment to starting and running the firm. That is, firm production is possible only if $E = 1$. $X_k > R_{1E}$ is a minimum resource requirement, indicating that the entrepreneur needs more than her own endowment (R_{1E}) to form capital.

To purchase resources, the entrepreneur needs finance from the bank. The bank is started and run by the banker, who, like the entrepreneur, devotes all his labor endowment to his business. The bank charges the lending interest rate for its loans, pays the deposit interest rate for deposits, and earns the interest spread.

2.2. Individual groups and their consumption and savings decisions

Individuals make their consumption and savings decisions each period to maximize utility, given the real resources they have at the time. Their decision horizon is two periods. The utility function for individual i is:

$$U_i = C_{1i} + \theta_i R_{2i} \tag{2.4}$$

where C_{1i} is period 1 consumption, R_{2i} is resources at the beginning of period 2. θ_i is the time preference parameter. We assume that the individuals are either "patient" with a high θ, or "impatient" with a low θ.

Individuals face different constraints depending on their occupations. Given the technologies, there are four different occupations in the economy: the home producer, the factory worker, the banker and the entrepreneur. We show in the Appendix that if the deposit interest rate exceeds a threshold, an individual (of any occupation) will choose to save the maximum amount; otherwise, they do not save. That is,

If $i_d > (P_2/P_1 - \theta_i)/\theta_i$, then, $C_{1i} = c_0 R_{1i}$, $S_{1i} = (1 - c_0)R_{1i}$

If $i_d \leq (P_2/P_1 - \theta_i)/\theta_i$, then, $C_{1i} = R_{1i}$, $S_{1i} = 0$

where R_{1i} is individual *i's* endowment at the beginning of period 1; and c_0 is the minimum proportion of the endowment that must be consumed (in order to live a period).

We assume in this paper that "patient" individuals have a sufficiently high θ so that the deposit interest rate exceeds the threshold for saving, and they choose to save the maximum amount. In contrast, "impatient" individuals have a sufficiently low θ so that they choose not to save. We further assume that the banker and the entrepreneur are "patient", and the "impatient" individuals are evenly distributed among the home producers and the factory workers. These assumptions allow us to divide the individuals into 6 groups. We describe the features of each group below.

(1) The entrepreneur. The entrepreneur starts a firm (factory) with her savings at the beginning of period 1. She receives a wage as factory manager and earns a required rate of return on her equity in the firm ("equity in production"). At the end of the period, she uses all her income and savings to buy good X from the firm.

(2) The banker. The banker starts a bank with his savings at the beginning of period 1. The banker receives a wage as bank manager and earns a required rate of return on his equity in the bank ("equity in banking"). At the end of the period, he uses all his income and savings to buy good X from the firm.

The entrepreneur and the banker as individuals are separate from the institutions of the firm and the bank. As we shall see later, loans are provided by the bank to the firm, not from the banker to the entrepreneur. Both the banker and the entrepreneur are customers of the bank, and both buy good X from the firm.

(3) Patient factory workers. Patient factory workers work in the factory for a wage. At the beginning of period 1, they sell their real savings to the firm and deposit the receipts with the bank. At the end of the period, they use their savings plus interest and their wages to buy good X from the firm.

(4) Impatient factory workers. Impatient factory workers work in the factory for a wage. They do not save. At the end of the period, they use their wages to buy good X from the firm.

(5) Patient home producers. Patient home producers use the home technology to produce good X for themselves. At the beginning of a period, they sell their real savings to the firm and deposit the receipts with the bank. At the end of the period, they use their savings plus interest to buy more good X from the firm to supplement their home production.

(6) Impatient home producers. Impatient home producers use the home technology to produce good X for themselves. They do not have money income, and do not participate in market transactions.

The individuals' purchases from the firm plus their home production (if any) become their resources at the beginning of period 2. The individuals make their consumption and savings decisions again given their new resources. The process repeats in subsequent periods. In this way, individuals' "long-run" decision consists of a chain of short-run decisions (Kalecki, 1968), and the economy evolves as one period gives way to the next, handing over inherited resources which form the basis for new decisions (Harcourt & Kriesler, 2023).

3. Model specification: the "good"

In this section, we model the economy in the "good" case, where the bank creates credit to finance only productive activities of the firm. We begin by presenting the stock and flow matrices of the economy (Table 3.1 and Table 3.2).

3.1. Stock and flow matrices

The stock matrix shows how each individual group's stock of real resources (i.e., quantities of good X) are allocated between consumptions and savings, and how they change over time.

As seen in Table 3.1, the first row shows the initial resources ("stock at the beginning for period 1") for each individual group. For example, the total stock of resources for patient home producers is equal to the number of patient home producers (N_{PHP}) multiply by each individual's resources (R_{1PHP}). The sum of the all groups' initial resources is R_1. The second row shows (with a negative sign) the level of resources each group sets aside for consumption during period 1. The difference between the initial endowment and consumption is real savings (shown in the third row). By assumption, only patient individuals save, thus the real savings of impatient home producers and impatient factory workers are zero. The fourth row displays the resources of individual groups at the beginning of period 2. These new levels of resources are the results of the individuals' production and market transactions during period 1, given their initial endowments.

The market transactions are recorded in the flow matrix (Table 3.2). The flow matrix shows the flow of funds associated with all market transactions. The flow matrix is essentially a record of changes on the bank's balance sheet. As seen in Table 3.2, apart from impatient home producers who do not participate in market transactions, the bank has deposit accounts (under liabilities) for all market participants: patient home producers, patient factory workers, impatient factory workers, the entrepreneur, the banker and the firm.

We record an increase in liabilities or net worth with a "+" sign, and an increase in assets with a "−" sign. Since money always comes from somewhere and goes somewhere, double-entry record-keeping ensures that each row sums to zero ((Godley & Lavoie, 2007). Each column also sums to zero, which means that all market participants are bound by their budget constraints and that the balance sheet balances.

Table 3.1. Stock matrix: the “Good”

Stock at beginning of period 1	Patient home producers	Impatient home producers	Patient factory workers	Impatient factory workers	Entrepreneur	Banker	Sum
Resource endowment	$N_{PHP}R_{1PHP}$	$N_{IHP}R_{1IHP}$	$N_{PFW}R_{1PFW}$	$N_{IFW}R_{1IFW}$	R_{1E}	R_{1B}	R_1
Consumption	$-N_{PHP}C_{1PHP}$	$-N_{IHP}C_{1IHP}$	$-N_{PFW}C_{1PFW}$	$-N_{IFW}C_{1IFW}$	$-C_{1E}$	$-C_{1B}$	$-C_1$
Real savings	$N_{PHP}S_{1PHP}$	0	$N_{PFW}S_{1PFW}$	0	S_{1E}	S_{1B}	S_1
Stock at beginning of period 2	$N_{PHP}R_{2PHP}$	$N_{IHP}R_{2IHP}$	$N_{PFW}R_{2PFW}$	$N_{IFW}R_{2IFW}$	R_{2E}	R_{2B}	R_2

Table 3.2. Flow matrix: the "Good"

	Assets	Liabilities						Net worth	Sum
Beginning of period 1		Home producers	Patient factory workers	Impatient factory workers	Entrepreneur	Banker	Firm		
1. Firm borrows from bank to form capital.	$-L_F$						$+L_F$		0
2. Firm purchases good X from savers.		$+N_{PHP}P_1S_{1PHP}$	$+N_{PFW}P_1S_{1PFW}$				$-L_F$	$+P_1S_{1B}$	0
End of period 1									
3. Firm borrows from bank to make factor payments.	$-L_{Fs}$						$+L_{Fs}$		0
4. Firm makes factor payments.			$+N_{PFW}W$	$+N_{IFW}W$	$+\gamma W + P_1S_{1E}(1 + r_E)$		$-L_{Fs}$	$+i_lL_F$	0
5. Bank pays depositors and the banker		$+i_dN_{PHP}P_1S_{1PHP}$	$+i_dN_{PFW}P_1S_{1PFW}$			$+\gamma W + P_1S_{1B}(1 + r_B)$		$-i_dP_1(N_{PHP}S_{1PHP} + N_{PFW}S_{1PFW}) - \gamma W - P_1S_{1B}(1 + r_B)$	0
6. Individuals purchase good X from firm		$-N_{PHP}P_2R^P{}_{2PHP}$	$-N_{PFW}P_2R_{2PFW}$	$-N_{IFW}P_2R_{2IFW}$	$-P_2R_{2E}$	$-P_2R_{2B}$	$+P_2X_f$	0	0
7. Firm repays bank	$+L_F + L_{Fs}$						$-P_2X_f$		0
Sum	0	0	0	0	0	0	0	0	0

Two transactions take place at the beginning of period 1.

1. The firm takes a one-period loan from the bank to purchase good X to form capital for factory production. This is recorded as an increase in the bank's assets ($-L_F$) and an equal increase in the firm's deposits ($+L_F$). In modern banking practice, the bank *creates* credit when it makes a loan (Werner, 2014, 2016), and "[m]ost of the money in the economy is created by banks when they provide loans".[1]
2. The firm uses the loan to purchase good X from savers, i.e., patient home producers, patient factory workers and the banker. With the purchase, the firm's deposit decreases by the amount of the loan ($-L_F$). The firm's expenditure equals the total revenue received by patient home producers ($+N_{PHP}P_1S_{1PHP}$)), patient factory workers ($+N_{PFW}P_1S_{1PFW}$) and the banker ($+P_1S_{1B}$), so that the row entries sum to zero.

After the firm has formed capital, it hires factory workers to produce good X during period 1. At the end of period 1 when production is completed, transactions 3-7 take place.

3. The firm takes a short-term loan from the bank to make factor payments. This loan increases the bank's assets ($-L_{Fs}$) and increases the firm's deposits ($+L_{Fs}$). For simplicity, this loan is assumed to be interest-free.
4. The firm makes factor payments. These payments include wages to patient and impatient factory workers ($+N_{PFW}W+ N_{IFW}W$), and interest to the bank for the first loan ($+i_lL_F$). The firm also pays a wage to the entrepreneur as factory manager (γW), and returns equity to the entrepreneur with the required rate of return ($+P_1S_{1E}(1 + r_E)$). The return of equity does not dissolve the firm; rather, it states the entrepreneur's claims in the firm in terms of money, so that the entrepreneur can participate in the distribution of factory output by purchasing goods from the firm. These factor payments transfer funds ($-L_{Fs}$) from the firm to factor owners.
5. The bank pays deposit interest to patient home producers ($+i_dN_{PHP}P_1S_{1PHP}$) and patient factory workers ($+i_dN_{PFW}P_1S_{1PFW}$). The bank also pays a wage to the banker as bank manager ($+\gamma W$), and returns equity to the banker with the required rate of return ($+P_1S_{1B}(1 + r_B)$). The bank's payments to depositors and the banker increase their deposit balances, which are matched by a decrease in the bank's net worth.
6. Individuals buy good X from the firm. These purchases distribute the firm's output to individuals based on their initial savings and the factor payments they receive. For example, patient home producers have their bank deposits ($+N_{PHP}P_1S_{1PHP}$) plus deposit interest ($+i_dN_{PHP}P_1S_{1PHP}$) at the end of period 1, which they use to fund their purchase from the firm ($-N_{PHP}P_2{R^P}_{2PHP}$). Individuals' purchases plus their home production (if any) become their resource stock at the beginning of period 2 as shown in the bottom row of the stock matrix (Table 3.1). The total expenditures of all individuals are equal to the total revenue of the firm (P_2X_f).
7. The firm repays both loans with its sales revenue. Provided that individuals spend all their monetary resources on the firm's output (which we assume is the case), the

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[1] See https://www.bankofengland.co.uk/explainers/how-is-money-created.

firm's total revenue exactly equals the total amount of the loans $(+L_F + L_{Fs} - P_2X_f = 0)$. Money is destroyed after the loan repayment, and the bank's balance sheet shrinks to zero.

The stock and flow matrices describe the distribution of resources at the beginning of a period, and the monetary transactions during the period that result in a new distribution of resources at the end of the period. The new distribution of resources becomes the starting point for a new round of production and monetary transactions in the next period, which gives rise to another distribution of resources, and so on. In this sense, the stock and flow matrices capture both the changing states of the model economy and the events that lead to the changes. To quantify these states and their changes, we construct a mathematical model, which is presented in the following subsection.

3.2. System of equations

The model consists of 40 equations that characterize the behavior of the system under 7 headings: (1) consumption and savings; (2) finance and capital formation; (3) production; (4) labor allocation and wages; (5) finance and factor payments; (6) pricing by the firm; (7) individual purchases. We discuss each in turn.

(1) Consumption and savings

As discussed in Section 2, if deposit interest rate exceeds a threshold level, individuals will choose minimum consumption and maximum savings; otherwise, they will choose maximum consumption and zero savings. We assume that "patient" individuals have a sufficiently high time preference parameter, so that they choose to save the maximum amount, whereas "impatient" individuals have a sufficiently low time preference parameter, so that they choose not to save. The consumption and savings for each individual group and the economy as a whole are characterized by the following equations, where C, S, R, N represent consumption, savings, resource endowment, and the number of individuals, respectively; the subscripts denote period and individual groups.

(i) Patient home producers (PHP)

$$C_{1PHP} = c_0 R_{1PHP} \tag{3.1}$$

$$S_{1PHP} = (1 - c_0) R_{1PHP} \tag{3.2}$$

(ii) Impatient home producers (IPH)

$$C_{1IHP} = R_{1IHP} \tag{3.3}$$

$$S_{1IHP} = 0 \tag{3.4}$$

(iii) Patient factory workers (PFW)

$$C_{1PFW} = c_0 R_{1PFW} \tag{3.5}$$

$$S_{1PFW} = (1 - c_0)R_{1PFW} \tag{3.6}$$

(iv) Impatient factory workers (IFW)

$$C_{1IFW} = R_{1IFW} \tag{3.7}$$

$$S_{1IFW} = 0 \tag{3.8}$$

(v) The entrepreneur (E)

$$C_{1E} = c_0 R_{1E} \tag{3.9}$$

$$S_{1E} = (1 - c_0)R_{1E} \tag{3.10}$$

(vi) The banker (B)

$$C_{1B} = c_0 R_{1B} \tag{3.11}$$

$$S_{1B} = (1 - c_0)R_{1B} \tag{3.12}$$

(vi) Total

Total resource endowment at the beginning of period 1:

$$R_1 = N_{PHP}R_{1PHP} + N_{IHP}R_{1IHP} + N_{PFW}R_{1PFW} + N_{IFW}R_{1IFW} + R_{1B} + R_{1E} \tag{3.13}$$

Total consumption in period 1:

$$C_1 = N_{PHP}C_{1PHP} + N_{IHP}C_{1IHP} + N_{PFW}C_{1PFW} + N_{IFW}C_{1IFW} + C_{1B} + C_{1E} \tag{3.14}$$

Total real savings in period 1:

$$S_1 = N_{PHP}S_{1PHP} + N_{PFW}S_{1PFW} + S_{1B} + S_{1E} \tag{3.15}$$

(2) Finance and capital formation

(i) By assumption, all real savings (S_1) are utilized for capital formation:

$$X_k = S_1 \tag{3.16}$$

where X_k is the quantity of good X used in capital formation.

(ii) To purchase real savings for capital formation, the firm takes a loan from the bank. The loan amount (L_F) is equal to the value of total real savings excluding the entrepreneur's own savings (S_{1E}):

$$L_F = P_1(X_k - S_{1E}) \tag{3.17}$$

where P_1 is the price of good X at the beginning of period 1. P_1 is the numeraire so that:

$$P_1 = 1 \tag{3.18}$$

(iii) The bank sets the lending interest rate

Given the deposit interest rate (which we assume is set by the monetary authority), the bank sets the lending interest rate (i_l) at a level so that the bank's interest income covers its costs and provides a required rate of return on equity in banking (r_B). The bank's costs include interest payments to depositors and wage paid to the banker as bank manager. The total deposits are the firm's payment to patient home producers and patient factory workers for their real savings ($P_1(N_{PHP}S_{1PHP} + N_{PFW}S_{1PFW})$). The manager's wage is assumed to be γ ($\gamma \geq 1$) times the factory worker's wage W. The higher wage compensates for the greater responsibilities involved in the manager role. The bank's equity is equal to the value of the banker's savings, P_1S_{1B}. Thus, we have:

$$i_lL_F = i_dP_1(N_{PHP}S_{1PHP} + N_{PFW}S_{1PFW}) + \gamma W + P_1S_{1B}r_B \tag{3.19}$$

The required rate of return on equity in banking, r_B, is assumed to be higher than the lending interest rate by a proportion (β):

$$r_B = (1 + \beta)i_l \tag{3.20}$$

(iv) Capital formation

Given the capital formation technology,

$$K = \begin{cases} bX_k, & \text{if } E = 1, \ \ X_k > R_{1E} \\ 0, & if\ E < 1, or\ X_k \leq R_{1E} \end{cases}$$

the total quantity of capital formed is:

$$K = bX_k \tag{3.21}$$

(3) Production

(i) Home production

Given the home technology,

$$X_h = al$$

the total output from home production is:

$$X_h = aN_{HP} \tag{3.22}$$

where N_{HP} is the total number of home producers.

(ii) Factory production

Given the factory technology,

$$x_f = \begin{cases} A[min(N_{FW}, K)], & \text{if } E = 1 \\ 0, & \text{if } E < 1 \end{cases}$$

the total factory output is:

$$X_f = AK \tag{3.23}$$

(4) Labor allocation and wages

(i) The number of factory workers employed is determined by the factory:

$$N_{FW} = K \tag{3.24}$$

(ii) We assume that a proportion μ of the home producers and factory workers are "impatient":

$$N_{IFW} = \mu N_{FW} \tag{3.25}$$

$$N_{PFW} = (1 - \mu)N_{FW} \tag{3.26}$$

The number of home producers is the total number of individuals, N, minus the number of factory workers, minus 2 (being the entrepreneur and the banker):

$$N_{HP} = N - N_{FW} - 2 \tag{3.27}$$

$$N_{IHP} = \mu N_{HP} \tag{3.28}$$

$$N_{PHP} = (1 - \mu)N_{HP} \tag{3.29}$$

(iv) The wage rate of factory workers, W, is determined when workers are hired at the beginning of period 1, but wages are paid at the end of period 1. The wage rate is equal to the opportunity cost of working in the factory evaluated at the prevailing price at the time of the labor contract. Thus, we have:

$$W = P_1 a \tag{3.30}$$

As discussed earlier, the banker as bank manager and the entrepreneur as factory manager receive a higher wage, γW, $(\gamma \geq 1)$.

(5) Finance and factor payments

(i) The firm borrows to make factory payments.

Before the factory output is sold, the firm has to take a short-term loan, L_{Fs}, (assumed to be interest-free) from the bank to make factor payments: loan interest, wages, and return on equity in production (r_P). The entrepreneur's equity, which is the value of the entrepreneur's initial savings, $P_1 S_{1E}$, is also monetized.

$$L_{Fs} = i_l L_F + N_{FW} W + \gamma W + P_1 S_{1E}(1 + r_P) \tag{3.31}$$

Assuming contestability, the required rate of return on equity in production and that in banking are equal:

$$r_P = r_B \tag{3.32}$$

(ii) The bank pays the depositors and the banker

The bank pays deposit interest at the end of period 1. It also pays a wage to the banker as bank manager and returns his equity plus the required rate of return in banking r_B. This is captured in equation (3.19) which describes how the banker sets the lending interest rate.

(6) Pricing by the firm

The firm sets its output price such that the firm covers its total cost of production and makes a required return on equity in production, r_P.

$$P_2 X_f = L_F(1 + i_l) + N_{FW} W + \gamma W + S_{1E}(1 + r_P) \tag{3.33}$$

(7) Purchases by individuals

After factory production is completed at the end of period 1, individuals spend all their monetary resources to purchase good X from the firm. These purchases (plus home production if any) become their resources at the beginning of period 2.

(i) The patient home producer pays for their purchases, R^p_{2PHP}, with their savings plus deposit interest:

$$P_2 R^p_{2PHP} = (1 + i_d) S_{1PHP} \tag{3.34}$$

The resources available to a patient home producer at the beginning of period 2 are the sum of their purchase and their home production:

$$R_{2PHP} = R^p_{2PHP} + a \tag{3.35}$$

(ii) The impatient home producer does not have money to purchase from the firm. The resources available to them at the beginning of period 2 are their own production in period 1:

$$R_{2IHP} = a \tag{3.36}$$

(iii) The patient factory worker pays for their purchase with their savings plus deposit interest and wage income:

$$P_2 R_{2PFW} = (1 + i_d) S_{1PFW} + W \quad (3.37)$$

(iv) The impatient factory worker pays for their purchase with their wage income:

$$P_2 R_{2IFW} = W \quad (3.38)$$

(v) The banker pays for his purchase with his wage income, savings, and the return on equity in banking:

$$P_2 R_{2B} = \gamma W + S_{1B}(1 + r_B) \quad (3.39)$$

(vi) The entrepreneur pays for her purchase with her wage income, savings and the return on equity in production:

$$P_2 R_{2E} = \gamma W + S_{1E}(1 + r_P) \quad (3.40)$$

(7) Loan repayment by the firm

After the firm has sold its output, it uses the sales revenue to repay both bank loans:

$$L_F + L_{Fs} = P_2 X_f$$

This is a redundant equation. It holds if all other equations in the system hold.

4. Model specification: the "Bad"

4.1. Stock and flow matrices

In the "bad" case, the bank creates credit to fund not only the firm's productive activities, but also impatient factory workers' consumption.

The stock matrix for the "bad" case is the same as that for the "good" case. To avoid duplication, we do not present it. The flow matrix has 3 additional transactions as a result of the consumption loans (see Table 4.1).

(1) Transaction 1. Each impatient factory worker takes a consumption loan (L_W) from the bank.

(2) Transaction 2. Impatient factory workers buy good X from patient factory workers.[2]

(3) Transaction 7. Impatient factory workers repay their loans with interest after they receive their wages.

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[2] Impatient factory workers can buy good X from any saver, not just patient factory workers. For presentational simplicity, we assume that they buy only from patient factory workers. We do not impose this assumption in the mathematical model.

4.2. System of equations

The system consists of 41 equations, many of which are the same as those in the "good" case. To avoid repetition, we highlight the differences below and provide the complete list of equations in the Appendix.

(1) There is one additional equation that specifies the consumption loan taken by the impatient factory worker, L_W. We assume that the loan amount is equal to a proportion (δ) of their wage income W:

$$L_W = \delta W \tag{4.1}$$

(2) The real savings available for capital formation is the total real savings minus the amount purchased by impatient workers with their consumption loans:

$$X_k = S_1 - N_{IFW}(L_W/P_1) \tag{4.2}$$

(3) The impatient factory worker repays their loan plus interest ($(1 + i_l)L_W$) before purchasing goods from the firm:

$$P_2R_{2IFW} = W - (1 + i_l)L_W \tag{4.3}$$

Table 4.1. Flow matrix: the "Bad"

	Assets	Liabilities						Net worth	Sum
Beginning of period 1		Patient home producers	Patient factory workers	Impatient factory workers	Entrepreneur	Banker	Firm		
1. Impatient factory worker borrows from bank	$-N_{IFW}L_W$			$+N_{IFW}L_W$					0
2. Impatient factory worker purchase good X from patient factory workers			$+N_{IFW}L_W$	$-N_{IFW}L_W$					0
3. Firm borrows from bank to form capital.	$-L_F$						$+L_F$		0
4. Firm purchases good X from savers.		$+N_{PHP}P_1S_{1PHP}$	$+N_{PFW}P_1S_{1PFW} - N_{IFW}L_W$				$-L_F$	$+P_1S_{1B}$	0
End of period 1									
5. Firm borrows from bank to make factor payments.	$-L_{Fs}$						$+L_{Fs}$		
6. Firm makes factor payments.			$+N_{PFW}W$	$+N_{IFW}W$	$+\gamma W + P_1S_{1E}(1 + r_P)$		$-L_{Fs}$	$+i_lL_F$	0
7. Impatient worker repays bank with interest	$+N_{IFW}L_W$			$-N_{IFW}L_W(1+i_l)$				$N_{IFW}L_Wi_l$	0
8. Bank pays depositors and banker		$+i_dN_{PHP}P_1S_{1PHP}$	$+i_dN_{PFW}P_1S_{1PFW}$			$+\gamma W + P_1S_{1B}(1 + r_B)$		$-i_dP_1(N_{PHP}S_{1PHP} + N_{PFW}S_{1PFW}) - \gamma W - P_1S_{1B}(1+r_B)$	0
9. Individuals purchase good X from firm		$-N_{PHP}P_2R^{P}{}_{2PHP}$	$-N_{PFW}P_2R_{2PFW}$	$-N_{IFW}P_2R_{2IFW}$	$-P_2R_{2E}$	$-P_2R_{2B}$	$+P_2X_2$	0	0
10. Firm repays bank	$+L_F + L_{Fs}$						$-P_2X_2$		0
Sum	0	0	0	0	0	0	0	0	0

5. Model specification: the "Ugly"

In the "ugly" case, the bank creates credit to fund both factory production and asset speculation. Starting from the "good" case, we introduce two speculators. To simplify calculations, we assume that speculator 1 buys the equity in the firm from the entrepreneur at period 1.33 (i.e, when 1/3 of the period has passed), and speculator 2 buys the equity in the firm from speculator 2 at period 1.67 (i.e., when 2/3 of the period has passed).[3] The asset purchase gives the buyer the right to equity returns; the entrepreneur as factory manager retains control over the firm. The purchases are financed by the bank.

5.1. Stock and flow matrices

The stock matrix of the ``ugly" case is similar to that of the ``good" case except that it has two additional columns, one for speculator 1, and another for speculator 2 (see Tables 5.1 and 5.2). We assume that the speculators come from the group of impatient home producers. That is, they consume all their endowed resources in period 1 and have zero real savings.

The flow matrix has 9 additional or modified transactions compared to the "good" case.

(1). Transaction 3. At period 1.33, speculator 1 takes a loan ($+\mathrm{L}_{\mathrm{S1}}$) from the bank to buy equity in the firm.

(2) Transaction 4. Speculator 1 uses his loan to buy the equity in the firm from the entrepreneur. The price of the equity ($\eta_1 P_1 S_{1E}(1+r_P), \eta_1 > 1$) allows the entrepreneur to earn a capital gain. Speculator 1 is willing to pay this price either because he believes that he can sell the asset to someone else later at a profit.

(3) Transaction 5. At period 1.67, speculator 2 takes a loan (L_{S2}) from the bank to buy equity in the firm.

(4) Transaction 6. Speculator 2 uses his loan to buy the firm from speculator 1. The price ($\eta_2 \eta_1 P_1 S_{1E}(1+r_P)$, $\eta_2 > 1$) gives speculator 1 a capital gain. Speculator 2 pays this price in anticipation that he will be able sell the asset at an even higher price.

(5) Transaction 7. Speculator 1 repays his loan with interest. Speculator 1's deposit balance decreases by the loan amount plus interest ($-L_{S2}(1+0.33 i_l)$); the bank's asset decreases by the loan amount ($+L_{S2}$) and the bank's net worth increases by the interest payment ($+0.33 i_l L_{S2}$). We assume that the price speculator 1 received is greater than the loan repayment.

(6) Transaction 9. The firm makes factor payments. The firm pays wages to patient factory workers ($+N_{PFW}W$), impatient factory workers (($+N_{IFW}W$), the entrepreneur as factory manager (γW), and returns equity (at speculator 2's purchase price) and the required rate of

[3] The number of speculators and the timing of their purchases can change without affecting the main conclusions we draw from the model.

return to speculator 2 ($\eta_2\eta_1 P_1 S_{1E}(1 + r_P)$).[4]

(7) Transaction 10. Speculator 2 defaults (since what he receives from the firm is insufficient to repay the bank loan with interest). The loan is canceled, and the bank gets the collateral value (which is the value of the equity in the firm). The bank's loss is shown as a fall in the bank's net worth ($+\eta_2\eta_1 P_1 S_{1E}(1 + r_P) - L_{S2}$).

(8) Transaction 11. The bank pays depositors and the banker. The bank pays depositors, including patient home producers, patient factory workers, the entrepreneur who deposited her receipts from selling the equity in the firm at period 1.33 and speculator 1 who deposited his net capital gains at period 1.67. The bank pays the banker a bank manager's wage, returns the equity contribution plus the bank's net earnings, which are the difference between total interest revenue and total costs ($C(i_d) + \gamma W$).

(9) Transaction 12. Individuals spend all their monetary resources good X from the firm. Speculator 1 has monetary resources since he sold the asset to speculator 2 at a profit. However, speculator 2 defaulted and has zero monetary resources.

[4] The value of the equity may be assessed differently. We also consider the scenario where the equity is valued at the book value ($P_1 S_{1E}$) in the mathematical model.

Table 5.1. Stock matrix: the "ugly"

STOCK at beginning of period 1	Patient home producers	Impatient home producer	Patient factory workers	Impatient factory workers	Entrepreneur	Banker	Speculator 1	Speculator 2	Sum
Resource endowment	$N_{PHP}R_{1PHP}$	$N_{IHP}R_{1IHP}$	$N_{PFW}R_{1PFW}$	$N_{IFW}R_{1IFW}$	R_{1E}	R_{1B}	R_{1S1}	R_{1S2}	R_1
Consumption out of endowment	$-N_{PHP}C_{1PHP}$	$-N_{IHP}C_{1IHP}$	$-N_{PFW}C_{1PFW}$	$-N_{IFW}C_{1IFW}$	C_{1E}	C_{1B}	C_{1E}	C_{1B}	C_1
Real savings	$N_{PHP}S_{1PHP}$	0	$N_{PFW}S_{1PFW}$	0	S_{1E}	S_{1B}	0	0	S_1
Stock at beginning of period 2	$N_{PHP}R_{2PHP}$	$N_{IHP}R_{2IHP}$	$N_{PFW}R_{2PFW}$	$N_{IFW}R_{2IFW}$	R_{2E}	R_{2B}	R_{2S1}	R_{2S2}	R_2

Table 5.2. Flow matrix: the "ugly"

	Assets	Liabilities								Net worth	Sum
Beginning of period 1		Patient Home producers	Patient factory workers	Impatient factory workers	Entrepreneur	Banker	Firm	Speculator 1	Speculator 2		
1. Firm borrows from bank to form capital.	$-L_F$						$+L_F$				0
2. Firm purchases good X from savers.		$+N_{PHP}P_1S_{1PHP}$	$+N_{PFW}P_1S_{1PFW} - N_{IFW}L_W$				$-L_F$			$+P_1S_{1B}$	0
3. At period 1.33, speculator 1 borrows to buy firm equity.	$-L_{S1}$							$+L_{S1}$			0
4. Speculator 1 buys firm from entrepreneur.					$+\eta_1P_1S_{1E}(1+r_P)$			$-L_{S1}$			0
5. At period 1.67, speculator 2 borrows to buy firm equity.	$-L_{S2}$								$+L_{S2}$		0
6. At period 1.67, speculator 2 buys firm equity from speculator 1.								$+\eta_2\eta_1P_1S_{1E}(1+r_P)$	$-L_{S2}$		0
7. Speculator 1 repays bank with interest.	$+L_{S1}$							$-L_{S1}(1+0.33i_l)$		$+0.33i_lL_{S1}$	0
End of period 1											
8. Firm borrows from bank to make factor payments.	$-L_{Fs}$						$+L_{Fs}$				
9. Firm makes factor payments.			$+N_{PFW}W$	$+N_{IFW}W$	$+\gamma W$		$-L_{Fs}$		$+\eta_2\eta_1P_1S_{1E}(1+r_P)$	$+i_lL_F$	0
10. Speculator 2 defaults, bank receives collateral value.	$+L_{S2}$								$-\eta_2\eta_1P_1S_{1E}(1+r_P)$	$+\eta_2\eta_1P_1S_{1E}(1+r_P) - L_{S2}$	0
11. Bank pays depositors and banker		$+i_dN_{PHP}P_1S_{1PHP}$	$+i_dN_{PFW}P_1S_{1PFW}$		$0.67i_d\eta_1P_1S_{1E}(1+r_P)$	$+\gamma W + P_1S_{1B} + NE$		$+0.33i_d[L_{S2}-(1+i_l)L_{S1}]$		$-C(i_d) - \gamma W - P_1S_{1B} - NE$	0
12. Individuals purchase good X from firm		$-N_{PHP}P_2R^P{}_{2PHP}$	$-N_{PFW}P_2R_{2PFW}$	$-N_{IFW}P_2R_{2IFW}$	$-P_2R_{2E}$	$-P_2R_{2B}$	$+P_2X_2$	$-P_2R_{2S1}$		0	0
13. Firm repays bank	$+L_F + L_{Fs}$						$-P_2X_2$				0
Sum	0	0	0	0	0	0			0	0	0

Notes: $C(i_d)$ is the bank's cost of interest paid to depositors, $C(i_d) = i_dN_{PHP}P_1S_{1PHP} + i_dN_{PFW}P_1S_{1PF} + 0.67i_d\eta_1P_1S_{1E}(1+r_P) + 0.33i_d[L_{S2} - (1+i_l)L_{S1}]$.
NE is the bank's net earnings: $NE = i_lL_F + 0.33i_lL_{S1} - C(i_d) - \gamma W$

5.2. System of equations

The model consists of 49 equations, many of which are the same as those in the “good” case. To avoid repetition, we present only the additional and different equations below and provide the complete list of equations in the Appendix.

(1) Consumption and savings

There are 4 additional equations characterizing consumption and savings of speculator 1 and speculator 2. We assume that the speculators come from the impatient home producer group, so they consume all their endowed real resources and do not save.

$$C_{1S1} = R_{1S1} \quad (5.1)$$

$$S_{1S1} = 0 \quad (5.2)$$

$$C_{1S2} = R_{1S2} \quad (5.3)$$

$$S_{1S2} = R_{1S2} \quad (5.4)$$

The total resource endowment and total consumption equations are amended to include the endowments and consumption amounts of the speculators:

$$R_1 = N_{PHP}R_{1PHP} + N_{IHP}R_{1IHP} + N_{PFW}R_{1PFW} + N_{IFW}R_{1IFW} + R_{1B} + R_{1E} + R_{1S2} + R_{1S2} \quad (5.5)$$

$$C_1 = N_{PHP}C_{1PHP} + N_{IHP}C_{1IHP} + N_{PFW}C_{1PFW} + N_{IFW}C_{1IFW} + C_{1B} + C_{1E} + C_{1S1} + C_{1S2} \quad (5.6)$$

(2) Labor allocation

The equation determining the number of impatient home producers is amended to account for the 2 speculators:

$$N_{IHP} = \mu N_{HP} - 2 \quad (5.7)$$

(3) Asset speculation

At period 1.33, speculator 1 offers the entrepreneur $\eta_1 P_1 S_{1E}(1 + r_P)$ ($\eta_1 > 1$) for the equity in the firm. The asset purchase is financed by a bank loan, L_{S1}:

$$L_{S1} = \eta_1 P_1 S_{1E}(1 + r_P) \quad (5.8)$$

At period 1.67, speculator 2 buys from speculator 1 the equity in the firm for the price $\eta_2\eta_1 P_1 S_{1E}(1 + r_P),\ \eta_2 > 1$). The purchase is financed by a bank loan, L_{S2}:

$$L_{S2} = \eta_2\eta_1 P_1 S_{1E}(1 + r_P) \quad (5.9)$$

(4) Finance and factor payments

Before the output is sold at the end of period 1, the firm takes a short-term loan (L_{Fs}) from the bank to make factor payments, which include interest on the first loan, wages, and return on equity in production (r_P). The monetary value of the equity is also returned to speculator 2. The valuation of the equity may be different. We consider two scenarios:

Scenario 1: equity is valued at the latest purchase price (i.e., the price paid by speculator 2).

$$L_{Fs} = i_l L_F + N_{FW} W + \gamma W + \eta_2 \eta_1 P_1 S_{1E}(1 + r_P) \quad (5.10)$$

Scenario 2: equity is valued at the initial book value, which is the amount contributed by the entrepreneur.

$$L_{Fs} = i_l L_F + N_{FW} W + \gamma W + P_1 S_{1E}(1 + r_P) \quad (5.10')$$

In either scenario, speculator 2 defaults. However, in scenario 1, speculator 2 receives from the firm the loan value ($\eta_2 \eta_1 P_1 S_{1E}(1 + r_P)$), so the bank loses only the interest payment. In scenario 2, the amount speculator 2 receives ($P_1 S_{1E}(1 + r_P)$) is less than the loan value, so the bank also loses some of the principal.

(5) Purchases by individuals

At the end of period 1, individuals use their monetary resources to buy good X from the firm. The equations describing the purchases of the banker and the entrepreneur are amended to reflect their changed income. Three equations are added to describe speculator 2's purchase, and the (real) resources available to speculator 1 and speculator 2.

(i) The banker receives the net worth of the bank, which equals the initial bank capital ($P_1 S_{1B}$) plus the bank's net income from lending.[5] In scenario 1, the net income is the difference between lending interest and deposit interest.

$$P_2 R_{2B} = P_1 S_{1B} + i_l L_F + 0.33 i_L L_{S1} - i_d (N_{PHP} P_1 S_{1PHP} + N_{PFW} P_1 S_{1PFW})$$
$$-0.67 i_d L_{S1} - 0.33 i_d [L_{S2} - (1 + 0.33 i_l) L_{S1}] \quad (5.11)$$

In scenario 2, the net income is equal to net interest income minus the loss of principal from the bad loan ($-L_{S2} + P_1 S_{1E}(1 + r_P)$).

$$P_2 R_{2B} = P_1 S_{1B} + i_l L_F + 0.33 i_L L_{S1} - i_d (N_{PHP} P_1 S_{1PHP} + N_{PFW} P_1 S_{1PFW}) - 0.67 i_d L_{S1}$$
$$-0.33 i_d [L_{S2} - (1 + 0.33 i_l) L_{S1}] - L_{S2} + P_1 S_{1E}(1 + r_P) \quad (5.11')$$

(ii) The entrepreneur's monetary resources include her wage as the factory manager (γW), the receipts from selling equity in the firm and the interest from depositing the receipts with the bank for 0.67 period ($(1 + 0.67 i_d) L_{S1}$).

[5] The banker's wage as bank manager is included in the net income.

$$P_2 R_{2E} = \gamma W + (1 + 0.67 i_d) L_{S1} \tag{5.12}$$

(iii) Speculator 1's monetary resources are his profit from speculation ($L_{S2} - L_{S1}(1 + 0.33 i_l)$ and the interest from depositing the profit with the bank for 0.33 period. He uses all his monetary resources to purchase good X from the firm:

$$P_2 R_{2S1}^p = (1 + 0.33 i_d)[L_{S2} - L_{S1}(1 + 0.33 i_l)] \tag{5.13}$$

Since speculator 1 is also a home producer, his total available resources at the beginning of period 2, R_{2S1}^p, are the sum of his purchase and his home production:

$$R_{2S1} = R_{2S1}^p + a \tag{5.14}$$

(iv) Speculator 2 has no monetary resources. His total available resources at the beginning of period 2 are his home production:

$$R_{2S2} = a \tag{5.15}$$

6. Numerical solutions

6.1. Parameter values

We numerically solve the systems of equations for the three cases: the "good", the "bad", and the "ugly" (two scenarios). For all cases, we set the following parameter values:

(1) Initial endowment: $R_{1PHP} = R_{1IHP} = R_{1PFW} = R_{1IFW} = R_1E = R_{1B} = 3$
(2) Propensity to consume: $c_0 = 0.7$
(3) Population: $N = 100$
(4) Proportion of impatient home producers and factory workers: $\mu = 0.1$
(5) Productivity parameters:
    (i) Home production: $a = 3$
    (ii) Factory production: $A = 10$
    (iii) Capital formation: $b = 0.3$
(6) Deposit interest rate: $i_d = 0.05$
(7) Manager-to-worker wage ratio: $\gamma = 1.5$
(8) Equity premium: $\beta = 0.1$

For the "bad" case, we set one additional parameter value, the amount of the consumption loan as a proportion of the wage rate: $\delta = 0.5$

For the "ugly" case, we set two additional parameter values: the ratio of speculator 1's offer price to the entrepreneur's minimum required price: $\eta_1 = 1.3$; the ratio of speculator 2's offer price to speculator 1's purchase price: $\eta_2 = 1.3$.

6.2. Economic outcome in period 1

The solutions to the systems of equations for the "good", the "bad" and the "ugly" cases are presented in Table 6.1.

Table 6.1: Numerical Solutions: the “Good”, the “Bad” and the “Ugly”

Row	Variables	Solutions			
		“Good”	“Bad”	“Ugly” (scenario 1)	“Ugly” (scenario 2)
1	$C_{1PHP} = C_{1PFW} = C_{1E} = C_{1B}$	2.100	2.100	2.100	2.100
2	C_{1IHP}	3.000	3.000	3.000	3.000
3	C_{1IFW}	3.000	4.500	3.000	3.000
4	$C_{1S1} = C_{1S2}$			3.000	3.000
5	$S_{1PHP} = S_{1PFW} = S_{1E} = S_{1B}$	0.900	0.900	0.900	0.900
6	$S_{1IHP} = S_{1IFW}$	0.000	0.000	0.000	0.000
7	$S_{1S1} = S_{1S2}$			0.000	0.000
8	R_1	300.000	300.000	300.000	300.000
9	C_1	218.820	222.316	218.820	218.820
10	S_1	81.180	81.180	81.180	81.180
11	N_{PHP}	66.281	67.225	66.281	66.281
12	N_{IHP}	7.365	7.469	5.365	5.365
13	N_{HP}	73.646	74.695	73.646	73.646
14	N_{PFW}	21.919	20.975	21.919	21.919
15	N_{IFW}	2.435	2.331	2.435	2.435
16	N_{FW}	24.354	23.305	24.354	24.354
17	X_k	81.180	77.684	81.180	81.180
18	K	24.354	23.305	24.354	24.354
19	x_h	220.938	224.084	220.938	220.938
20	x_f	243.540	233.053	243.540	243.540
21	L_F	80.280	76.784	80.280	80.280
22	L_{Fs}	87.142	83.623	87.836	87.142
23	L_W		1.500		
24	L_{S1}			1.307	1.307
25	L_{S2}			1.700	1.700
26	W	3.000	3.000	3.000	3.000
27	i_l	0.107	0.107	0.107	0.107
28	$r_B = r_B$	0.117	0.117	0.117	0.117
29	P_1	1.000	1.000	1.000	1.000
30	P_2	0.687	0.688	0.690	0.687
31	$R^P{}_{2PHP}$	1.375	1.373	1.369	1.375
32	R_{2PHP}	4.375	4.373	4.369	4.375
33	R_{2IHP}	3.000	3.000	3.000	3.000
34	R_{2PFW}	5.739	5.732	5.715	5.739
35	R_{2IFW}	4.364	1.947	4.346	4.364
36	R_{2B}	8.009	7.999	7.971	6.994
37	R_{2E}	8.009	7.999	8.476	8.512
38	$R^P{}_{2S1}$			0.510	0.512
39	R_{2S1}	3.510	3.512		
40	R_{2S2}	3.000	3.000		

The “ugly” case has two scenarios: in scenario 1, speculator 2's equity in the firm is valued at speculator 2's purchase price; in scenario 2, it is valued at initial book value. We compare the solutions in each case, focusing on wealth creation and distribution.

Consider wealth creation first. We note that bank credit for production is present in all cases. Without bank credit, factory production would not be possible, and all individuals would be home producers, in which case the total output would be $300(= aN)$.

With bank credit, the firm can form capital and adopt the more productive factory technology. The total wealth created in the economy is the sum of home production and factory production. As seen in rows 19 and 20 of Table 6.1, in the “good” case and the “ugly” case, the total output is 464.478 (= 220.938 + 243.540), which is 54.8% higher than the counterfactual of no factory production. We have assumed that speculative activities do not consume real resources, and that speculation takes place after resources have already been allocated in production. This means speculation does not affect the level of real resources available or their allocation, therefore, the total output in the “ugly” case is the same as that in the “good” case.

In the “bad” case, the total output is 457.137 (=224.84 + 233.053), which is 52.3% higher than the counterfactual, but 1.6% lower than that of the “good” case. Since the consumption credit given to impatient factory workers allows them to consume more than their endowment at the beginning of period 1, the real savings available for capital formation is reduced. This means a smaller amount of capital is used in production, and factory output is smaller than that in the “good” case. Although home production is higher, the increase in home production is outweighed by the loss in factory production since home productivity is lower.

Now consider wealth distribution. In the “good” case, the output of factory production is distributed to individuals on the basis of their monetary resources, and monetary resources they receive reflect their contributions to factory production. The patient home producer contributes real savings, and receives deposit interest in return. The impatient factory worker receives a wage for contributing labor; the patient factory worker receives both a wage and deposit interest for contributing both labor and real savings. The banker and the entrepreneur contribute management skills and equity in their business, in return they receive a (higher) wage and returns to equity. The impatient home producer does not contribute to factory production, and they do not benefit it. Their wealth at the beginning of period 2 is just their home production during period 1 ($R_{2IHP} = 3.000$).

The distribution pattern in the “bad” case is similar to that in the “good” case. Since the total wealth created is smaller than that in the “good” case, everyone has fewer real resources at the end of period 1. Notably, the impatient factory worker has 1.947 real resources (row 35) after repaying their consumption loan. Their real wealth (including consumption) is 6.447 (= 1.947 + 4.500). This is lower than what they have in the good case, which is 7.364 (= 4.364 + 3.000). While the impatient factory worker may be better off in utility terms as they can have more consumption at an earlier time, this utility gain is at the cost of lower material wealth for other market participants.

In the “ugly” case, speculative activities financed by bank credit disrupt the contribution-based distribution pattern that prevails in the “good” case. First consider scenario 2 where speculator 2's equity in the firm is valued at its original book value. In this scenario, the total credit in the economy ($L_F + L_{Fs}$) is the same as that in the “good” case, so the price for the factory output (P_2) is also the same. As a result, the individuals who have not participated in speculative activities still obtain the same level of real resources at the end of the period (rows 32 -35). The winners of speculation, namely, the entrepreneur and speculator 1, obtain more wealth through financial capital gains. Speculator 2 overpaid in the speculation, but by defaulting on his bank loan, the loss is shouldered by the banker. The banker's loss (= 8.009-6.994 = 1.015, row 36) is equal to the total gains of the entrepreneur (= 0.503 = 8.512-8.009, row 37) and speculator 1 (= 0.512, row 38). In other words, the speculative activities result in a simple transfer of real wealth from the loser to the winners of speculation.

Now consider scenario 1 of the “ugly” case where speculator 2's equity in the firm is valued at his purchase price. Because of the higher valuation, the bank lends more to the firm for factor payments (row 22, L_{FS}). This increases total credit, which leads to higher price for the factory output (row 30), and reduces the real wealth of everyone with a given nominal income. Thus, the patient home producer (row 32), the patient factory worker (row 34) and the impatient factory worker (row 35) are all worse off. The entrepreneur and speculator 1 also obtain slightly smaller real gains for their speculative activities (rows 37 and 39). Meanwhile, the banker's loss is reduced considerably (row 36). In effect, the higher level of credit provided to the firm L_{FS}) has “validated” speculator 2's (overpaid) purchase price as the value of the equity in the firm even though there is no increase in the true value of the firm. As the increased credit dilutes the purchasing power of money, the bank is able to pass on some of its losses from speculator 2's default to everyone else holding money.

6.3. Path to steady state

Rows 32 -37, and 39-40 of Table 6.1 show that at the end of period 1, all individuals have some real resources available to them. These become the individuals' endowments at the beginning of period 2, and the individuals make their decisions anew. The new decisions will give them different quantities of resources available at the beginning of period 3, and so on.

In the “good” and the “bad” cases, there are no revealed mistakes in decision-making, so it is reasonable to assume that the individuals will follow the same decision criteria, and the system can (potentially) reach a steady state where each individual's quantity of resources at the end of the period equals that in at the beginning of the period. However, in the “ugly” case, the losers of speculation are unlikely to repeat their mistakes again and again, so there is no steady state. The more likely scenario is that after taking losses from bad loans, the bank will be more cautious in extending credit for speculation in the next period. Over time, as the memory of losses fades, the bank may become bold again. Thus, credit for speculative purposes may exhibit a cyclical pattern similar to that described in Minsky (2008). We do not attempt to model the credit cycle for speculative activities here.[6] We only trace the paths to steady state for the “good” case and the “bad” case by numerically solving the systems of equations for each period until the steady state is reached. In both cases, the economy reaches a steady state in period 14. The solutions to the variables of our main interest are presented in Tables 6.2 – 6.4.

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[6] It should be noted that speculative lending is likely to be the result of banks competing with each other, each betting that its own clients are the winners rather than losers of speculation. Thus, the bank in this model needs to be seen as the “banking sector”. The banking sector as a whole will lose from speculative lending.

Table 6.2: Path to Steady State: Labor, Capital and Production

Period	N_{HP}		N_{FW}		K		x_h		x_f	
	"Good"	"Bad"	"Good"	"Bad"	"Good"	"Bad"	"Good"	"Bad"	"Good"	"Bad"
1	73.646	74.695	24.354	23.305	24.354	23.305	220.938	224.084	243.540	233.053
2	57.341	59.332	40.659	38.668	40.659	38.668	172.022	177.996	406.595	386.679
3	47.418	50.080	50.582	47.920	50.582	47.920	142.254	150.239	505.820	479.202
4	41.887	44.956	56.113	53.044	56.113	53.044	125.661	134.867	561.132	530.443
5	38.959	42.254	59.041	55.746	59.041	55.746	116.877	126.762	590.409	557.460
6	37.453	40.867	60.547	57.133	60.547	57.133	112.358	122.602	605.473	571.327
7	36.689	40.166	61.311	57.834	61.311	57.834	110.068	120.497	613.107	578.345
8	36.305	39.813	61.695	58.187	61.695	58.187	108.916	119.439	616.946	581.870
9	36.113	39.637	61.887	58.363	61.887	58.363	108.339	118.910	618.869	583.634
10	36.017	39.548	61.983	58.452	61.983	58.452	108.051	118.645	619.831	584.515
11	35.969	39.505	62.031	58.495	62.031	58.495	107.907	118.514	620.311	584.955
12	35.945	39.483	62.055	58.517	62.055	58.517	107.835	118.448	620.550	585.174
13	35.933	39.472	62.067	58.528	62.067	58.528	107.799	118.415	620.670	585.283
14	35.927	39.466	62.073	58.534	62.073	58.534	107.781	118.399	620.729	585.338

Table 6.3: Path to Steady State: Credit and Prices

Period	L_F		L_{Fs}		i_l		$r_B = r_P$		P_2	
	"Good"	"Bad"	"Good"	"Bad"	"Good"	"Bad"	"Good"	"Bad"	"Good"	"Bad"
1	80.280	76.784	87.142	83.623	0.107	0.107	0.117	0.117	0.687	0.688
2	133.129	126.493	140.364	133.854	0.085	0.085	0.093	0.093	0.673	0.673
3	165.428	156.560	172.581	163.947	0.078	0.078	0.086	0.086	0.668	0.669
4	183.475	173.250	190.494	180.571	0.075	0.075	0.083	0.083	0.666	0.667
5	193.038	182.060	199.964	189.325	0.074	0.074	0.081	0.082	0.666	0.666
6	197.961	186.585	204.833	193.815	0.073	0.074	0.081	0.081	0.665	0.666
7	200.457	188.875	207.300	196.086	0.073	0.073	0.080	0.081	0.665	0.666
8	201.713	190.025	208.540	197.227	0.073	0.073	0.080	0.081	0.665	0.666
9	202.341	190.601	209.161	197.798	0.073	0.073	0.080	0.080	0.665	0.665
10	202.656	190.889	209.472	198.083	0.073	0.073	0.080	0.080	0.665	0.665
11	202.813	191.033	209.627	198.226	0.073	0.073	0.080	0.080	0.665	0.665
12	202.891	191.104	209.704	198.297	0.073	0.073	0.080	0.080	0.665	0.665
13	202.930	191.140	209.743	198.332	0.073	0.073	0.080	0.080	0.665	0.665
14	202.950	191.158	209.762	198.350	0.073	0.073	0.080	0.080	0.665	0.665

Table 6.4: Path to Steady State: End of Period Resources

Period	R_{2PHP}		R_{2IHP}		R_{2PFW}		R_{2IFW}		$R_{2E} = R_{2B}$	
	"Good"	"Bad"	"Good"	"Bad"	"Good"	"Bad"	"Good"	"Bad"	"Good"	"Bad"
1	4.375	4.373	3.000	3.000	5.739	5.732	4.364	1.947	8.009	7.999
2	5.049	5.046	3.000	3.000	7.147	7.137	4.460	2.039	10.594	10.580
3	5.380	5.376	3.000	3.000	7.859	7.847	4.489	2.067	11.898	11.882
4	5.543	5.539	3.000	3.000	8.216	8.203	4.501	2.079	12.551	12.534
5	5.623	5.619	3.000	3.000	8.395	8.382	4.507	2.084	12.877	12.860
6	5.663	5.658	3.000	3.000	8.485	8.471	4.510	2.087	13.040	13.023
7	5.682	5.678	3.000	3.000	8.529	8.516	4.511	2.088	13.121	13.104
8	5.692	5.687	3.000	3.000	8.552	8.538	4.511	2.089	13.161	13.144
9	5.696	5.692	3.000	3.000	8.563	8.550	4.512	2.089	13.181	13.164
10	5.699	5.694	3.000	3.000	8.569	8.555	4.512	2.089	13.191	13.174
11	5.700	5.695	3.000	3.000	8.572	8.558	4.512	2.089	13.196	13.179
12	5.700	5.696	3.000	3.000	8.573	8.559	4.512	2.089	13.199	13.182
13	5.701	5.696	3.000	3.000	8.574	8.560	4.512	2.089	13.200	13.183
14	5.701	5.696	3.000	3.000	8.574	8.560	4.512	2.089	13.201	13.184

Table 6.2 shows the paths to steady state for labor, capital, and production. We see that the amount of capital used in factory production (K) increases over time. This means the number of factory workers (N_{FW}) increases, and the number of home producers (N_{HP}) falls. Thus, factory production increases, home production decreases, and total output increases. Compared to the "good" case, the "bad" case has lower levels of capital, factory workers, factory output, and total output in every period. In particular, the steady-state total output in the "bad" case is 703.737 (= 118.399 + 585.338), which is 3.5% lower than the total output of 728.51 (=107.781 + 620.729) in the "good" case. Notably, in the steady states of both cases, some workers remain in home production. This is because the demand for factory workers is determined by capital formation. As the economy approaches the steady state, capital formation increases at a diminishing rate until it converges to zero. Consequently, the demand for factory workers also rises at a diminishing rate and eventually stagnates. There is no mechanism guaranteeing that all workers transition to factory employment.

Table 6.3 shows the paths to steady state for credit and prices. Credit required for capital formation (L_F) increases over time as the capital employed in factory production increases. Similarly, credit required for factor payments increases with the scale of factory production. Since the levels of capital and factory output are higher in the "good" case, the level of credit is also higher. Prices, including the lending interest rate (i_l), the required rate of return (r_B and r_P), and the price of good X (P_2) all fall for some periods before the system reaches the steady state in period 14. There are only minor price differences between the "good" case and the "bad" case.

Table 6.4 shows the paths to steady state for resources at the end of each period. Apart from impatient home producers who do not participate in market transactions, the real resources available to everyone else increase over time until the steady state is reached. In every period, the entrepreneur and the banker have the most resources, followed by the patient factory worker, the patient home producer, the impatient factory worker, and the impatient home producer. Also, everyone except the impatient home producer has more resources in the "good" case than in the "bad" case.

In summary, relative to the "good" case with only production loans, the introduction of consumption loans in the "bad" case leads to lower total output in every period on the path to steady state. As a result, everyone has fewer real resources in each period. The consumption loan may have benefited the impatient factory workers by allowing them to consume more at an earlier date, but it reduces the real wealth of everyone else by lowering the economy's total output.

7. Conclusion

In this paper, we have developed a stock-flow consistent model to study the effects of three different types of credit creation on wealth creation and distribution. In this model (as in the real world), the bank does not collect deposits to make loans. Rather, credit and deposits are created at the same time. When credit for production is created, the firm receives a deposit with which it buys real resources from savers. When credit for consumption is created, impatient factory workers receive a deposit with which they compete with the firm for the available real savings. When credit for speculation is created, the speculators receive a deposit with which they bid up asset prices.

The main conclusions of this paper are threefold.

First, credit for production (the "good") enables capital formation and the adoption of more productive technologies. As a result, more real wealth is created, and the distribution of wealth reflects individuals' contributions to the wealth creation process.

Second, credit for consumption (the "bad") reduces real savings available for capital formation and limits the scale of the more productive factory production. This reduces the real wealth of every market participant.

Third, credit for speculation (the "ugly") funds a game of wealth transfers unrelated to wealth creation. People may willingly participate in the game knowing that they may gain or lose. However, the game can also take wealth from non-participants if speculation leads to credit expansion and a dilution of money's purchasing power.

In all three cases of the model, credit for production is indispensable for the initiation and continuation of factory production. Each round of production begins with lending and ends with repayment of loans. A growing economy requires an increasing amount of production loans. As the provider of credit for production, the bank is in a sense the planner and organizer of social production. It allocates real resources to the production process that generates sufficient value to cover all input costs, including loan interest. These real resources are productive capital. A key social function of the bank is to allocate productive capital efficiently.

In this model, allocating real savings to impatient factory workers for consumption is inefficient in the sense that it prevents the full realization of the economy's productive potential. However, consumption credit is not "bad" per se. For example, if there is an unexpected money hoarding by some individuals, the firm may not generate sufficient sales to repay its loans. In this situation, consumption credit could be a simple way to increase effective demand and to avoid loan delinquency.

In this model, speculative credit does not give rise to inefficiency as it does not affect wealth creation. However, it alters the distribution of wealth, and thus affect equity. We have not considered any potential benefit of speculation suggested in the literature, such as its role in facilitating price discovery and enhancing market liquidity (Amihud & Mendelson, 1986). At the same time, we have not taken into account the resource costs associated with speculative activities (Cecchetti & Kharroubi, 2012}.

This model can be extended in several directions. For instance, we can study the paradox of thrift by allowing individuals to hoard cash. The model can also include a government and a central bank, enabling an analysis of the interplay between private bank credit and fiat money generated through government deficits and central bank lending. Such an extension could produce new insights into the transmission mechanisms of fiscal and monetary policies.

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Appendix A. Equation lists

A.1. The "Good"

$$C_{1PHP} = c_0 R_{1PHP} \quad (A.1.1)$$

$$S_{1PHP} = (1 - c_0) R_{1PHP} \quad (A.1.2)$$

$$C_{1IHP} = R_{1IHP} \quad (A.1.3)$$

$$S_{1IHP} = 0 \quad (A.1.4)$$

$$C_{1PFW} = c_0 R_{1PFW} \quad (A.1.5)$$

$$S_{1PFW} = (1 - c_0) R_{1PFW} \quad (A.1.6)$$

$$C_{1IFW} = R_{1IFW} \quad (A.1.7)$$

$$S_{1IFW} = 0 \quad (A.1.8)$$

$$C_{1E} = c_0 R_{1E} \quad (A.1.9)$$

$$S_{1E} = (1 - c_0) R_{1E} \quad (A.1.10)$$

$$C_{1B} = c_0 R_{1B} \quad (A.1.11)$$

$$S_{1B} = (1 - c_0) R_{1B} \quad (A.1.12)$$

$$R_1 = N_{PHP} R_{1PHP} + N_{IHP} R_{1IHP} + N_{PFW} R_{1PFW} + N_{IFW} R_{1IFW} + R_{1B} + R_{1E} \quad (A.1.13)$$

$$C_1 = N_{PHP} C_{1PHP} + N_{IHP} C_{1IHP} + N_{PFW} C_{1PFW} + N_{IFW} C_{1IFW} + C_{1B} + C_{1E} \quad (A.1.14)$$

$$S_1 = N_{PHP} S_{1PHP} + N_{PFW} S_{1PFW} + S_{1B} + S_{1E} \quad (A.1.15)$$

$$X_k = S_1 \quad (A.1.16)$$

$$L_F = P_1 (X_k - S_{1E}) \quad (A.1.17)$$

$$P_1 = 1 \quad (A.1.18)$$

$$i_l L_F = i_d P_1 (N_{PHP} S_{1PHP} + N_{PFW} S_{1PFW}) + \gamma W + P_1 S_{1B} (1 + r_B) \quad (A.1.19)$$

$$r_B = (1 + \beta) i_l \quad (A.1.20)$$

$$K = b X_k \quad (A.1.21)$$

$$X_h = a N_{HP} \quad (A.1.22)$$

$$X_f = AK \quad (A.1.23)$$

$$N_{FW} = K \tag{A.1.24}$$

$$N_{IFW} = \mu N_{FW} \tag{A.1.25}$$

$$N_{PFW} = (1 - \mu)N_{FW} \tag{A.1.26}$$

$$N_{HP} = N - N_{FW} - 2 \tag{A.1.27}$$

$$N_{IHP} = \mu N_{HP} \tag{A.1.28}$$

$$N_{PHP} = (1 - \mu)N_{HP} \tag{A.1.29}$$

$$W = P_1 a \tag{A.1.30}$$

$$L_{Fs} = i_l L_F + N_{FW} W + \gamma W + P_1 S_{1E}(1 + r_P) \tag{A.1.31}$$

$$r_P = r_B \tag{A.1.32}$$

$$P_2 X_f = L_F(1 + i_l) + N_{FW} W + \gamma W + S_{1E}(1 + r_P) \tag{A.1.33}$$

$$P_2 R_{2PHP}^p = (1 + i_d) S_{1PHP} \tag{A.1.34}$$

$$R_{2PHP} = R_{2PHP}^p + a \tag{A.1.35}$$

$$R_{2IHP} = a \tag{A.1.36}$$

$$P_2 R_{2PFW} = (1 + i_d) S_{1PFW} + W \tag{A.1.37}$$

$$P_2 R_{2IFW} = W \tag{A.1.38}$$

$$P_2 R_{2B} = \gamma W + S_{1B}(1 + r_B) \tag{A.1.39}$$

$$P_2 R_{2E} = \gamma W + S_{1E}(1 + r_E) \tag{A.1.40}$$

A.2. The “Bad”

$$C_{1PHP} = c_0 R_{1PHP} \tag{A.2.1}$$

$$S_{1PHP} = (1 - c_0) R_{1PHP} \tag{A.2.2}$$

$$C_{1IHP} = R_{1IHP} \tag{A.2.3}$$

$$S_{1IHP} = 0 \tag{A.2.4}$$

$$C_{1PFW} = c_0 R_{1PFW} \tag{A.2.5}$$

$$S_{1PFW} = (1 - c_0) R_{1PFW} \tag{A.2.6}$$

$$C_{1IFW} = R_{1IFW} + L_w / P_1 \tag{A.2.7}$$

$$S_{1IFW} = 0 \tag{A.2.8}$$

$$C_{1E} = c_0 R_{1E} \tag{A.2.9}$$

$$S_{1E} = (1 - c_0) R_{1E} \tag{A.2.10}$$

$$C_{1B} = c_0 R_{1B} \tag{A.2.11}$$

$$S_{1B} = (1 - c_0) R_{1B} \tag{A.2.12}$$

$$R_1 = N_{PHP} R_{1PHP} + N_{IHP} R_{1IHP} + N_{PFW} R_{1PFW} + N_{IFW} R_{1IFW} + R_{1B} + R_{1E} \tag{A.2.13}$$

$$C_1 = N_{PHP} C_{1PHP} + N_{IHP} C_{1IHP} + N_{PFW} C_{1PFW} + N_{IFW} C_{1IFW} + C_{1B} + C_{1E} \tag{A.2.14}$$

$$S_1 = N_{PHP} S_{1PHP} + N_{PFW} S_{1PFW} + S_{1B} + S_{1E} \tag{A.2.15}$$

$$L_W = \theta W \tag{A.2.16}$$

$$X_k = S_1 - N_{IFW}(L_W / P_1) \tag{A.2.17}$$

$$L_F = P_1 (X_k - S_{1E}) \tag{A.2.18}$$

$$P_1 = 1 \tag{A.2.19}$$

$$i_l (L_F + N_{IFW} L_W) = i_d P_1 [(N_{PHP} S_{1PHP}) + (N_{PFW} S_{1PFW})] + \gamma W + P_1 S_{1B} r_B \tag{A.2.20}$$

$$r_B = (1 + \beta) i_l \tag{A.2.21}$$

$$K = b X_k \tag{A.2.22}$$

$$X_h = a N_{HP} \tag{A.2.23}$$

$$X_f = AK \tag{A.2.24}$$

$$N_{FW} = K \tag{A.2.24}$$

$$N_{IFW} = \mu N_{FW} \tag{A.2.26}$$

$$N_{PFW} = (1 - \mu) N_{FW} \tag{A.2.27}$$

$$N_{HP} = N - N_{FW} - 2 \tag{A.2.28}$$

$$N_{IHP} = \mu N_{HP} \tag{A.2.29}$$

$$N_{PHP} = (1 - \mu) N_{HP} \tag{A.2.30}$$

$$W = P_1 a \tag{A.2.31}$$

$$L_{Fs} = i_l L_F + N_{FW} W + \gamma W + P_1 S_{1E} (1 + r_P) \tag{A.2.32}$$

$$r_P = r_B \quad (A.2.33)$$

$$P_2 X_f = L_F(1 + i_l) + N_{FW}W + \gamma W + S_{1E}(1 + r_P) \quad (A.2.34)$$

$$P_2 R^p_{2PHP} = (1 + i_d)S_{1PHP} \quad (A.2.35)$$

$$R_{2PHP} = R^p_{2PHP} + a \quad (A.2.36)$$

$$R_{2IHP} = a \quad (A.2.37)$$

$$P_2 R_{2PFW} = (1 + i_d)S_{1PFW} + W \quad (A.2.38)$$

$$P_2 R_{2IFW} = W \quad (A.2.38)$$

$$P_2 R_{2B} = \gamma W + S_{1B}(1 + r_B) \quad (A.2.40)$$

$$P_2 R_{2E} = \gamma W + S_{1E}(1 + r_P) \quad (A.2.41)$$

A.3. The "Ugly"

$$C_{1PHP} = c_0 R_{1PHP} \quad (A.3.1)$$

$$S_{1PHP} = (1 - c_0)R_{1PHP} \quad (A.3.2)$$

$$C_{1IHP} = R_{1IHP} \quad (A.3.3)$$

$$S_{1IHP} = 0 \quad (A.3.4)$$

$$C_{1PFW} = c_0 R_{1PFW} \quad (A.3.5)$$

$$S_{1PFW} = (1 - c_0)R_{1PFW} \quad (A.3.6)$$

$$C_{1IFW} = R_{1IFW} \quad (A.3.7)$$

$$S_{1IFW} = 0 \quad (A.3.8)$$

$$C_{1E} = c_0 R_{1E} \quad (A.3.9)$$

$$S_{1E} = (1 - c_0)R_{1E} \quad (A.3.10)$$

$$C_{1B} = c_0 R_{1B} \quad (A.3.11)$$

$$S_{1B} = (1 - c_0)R_{1B} \quad (A.3.12)$$

$$C_{1S1} = R_{1S1} \quad (A.3.13)$$

$$S_{1S1} = 0 \quad (A.3.14)$$

$$C_{1S2} = R_{1S2} \quad (A.3.15)$$

$$S_{1S2} = R_{1S2} \qquad (A.3.16)$$

$$R_1 = N_{PHP}R_{1PHP} + N_{IHP}R_{1IHP} + N_{PFW}R_{1PFW} + N_{IFW}R_{1IFW} + R_{1B} + R_{1E} + R_{1S2} + R_{1S2} \qquad (A.3.17)$$

$$C_1 = N_{PHP}C_{1PHP} + N_{IHP}C_{1IHP} + N_{PFW}C_{1PFW} + N_{IFW}C_{1IFW} + C_{1B} + C_{1E} + C_{1S1} + C_{1S2} \qquad (A.3.18)$$

$$S_1 = N_{PHP}S_{1PHP} + N_{PFW}S_{1PFW} + S_{1B} + S_{1E} \qquad (A.3.19)$$

$$X_k = S_1 \qquad (A.3.20)$$

$$L_F = P_1(X_k - S_{1E}) \qquad (A.3.21)$$

$$P_1 = 1 \qquad (A.3.22)$$

$$i_l L_F = i_d P_1(N_{PHP}S_{1PHP} + N_{PFW}S_{1PFW}) + \gamma W + P_1 S_{1B}(1 + r_B) \qquad (A.3.23)$$

$$r_B = (1 + \beta)i_l \qquad (A.3.24)$$

$$K = bX_k \qquad (A.3.25)$$

$$X_h = aN_{HP} \qquad (A.3.26)$$

$$X_f = AK \qquad (A.3.27)$$

$$N_{FW} = K \qquad (A.3.28)$$

$$N_{IFW} = \mu N_{FW} \qquad (A.3.29)$$

$$N_{PFW} = (1 - \mu)N_{FW} \qquad (A.3.30)$$

$$N_{HP} = N - N_{FW} - 2 \qquad (A.3.31)$$

$$N_{IHP} = \mu N_{HP} - 2 \qquad (A.3.32)$$

$$N_{PHP} = (1 - \mu)N_{HP} \qquad (A.3.33)$$

$$W = P_1 a \qquad (A.3.34)$$

$$L_{S1} = \eta_1 P_1 S_{1E}(1 + r_P) \qquad (A.3.35)$$

$$L_{S2} = \eta_2 \eta_1 P_1 S_{1E}(1 + r_P) \qquad (A.3.36)$$

$$L_{Fs} = i_l L_F + N_{FW}W + \gamma W + \eta 2\eta 1 P_1 S_{1E}(1 + r_P) \qquad (A.3.37)$$

$$L_{Fs} = i_l L_F + N_{FW}W + \gamma W + P_1 S_{1E}(1 + r_P) \qquad (A.3.37')$$

$$r_P = r_B \qquad (A.3.38)$$

$$P_2 X_f = L_F + L_F s \qquad (A.3.39)$$

$$P_2R^p_{2PHP} = (1 + i_d)S_{1PHP} \quad (A.3.40)$$

$$R_{2PHP} = R^p_{2PHP} + a \quad (A.3.41)$$

$$R_{2IHP} = a \quad (A.3.42)$$

$$P_2R_{2PFW} = (1 + i_d)S_{1PFW} + W \quad (A.3.43)$$

$$P_2R_{2IFW} = W \quad (A.3.44)$$

$$P_2R_{2B} = P_1S_{1B} + i_lL_F + 0.33i_LL_{S1} - i_d(N_{PHP}P_1S_{1PHP} + N_{PFW}P_1S_{1PFW})$$

$$-0.67i_dL_{S1} - 0.33i_d[L_{S2} - (1 + 0.33i_l)L_{S1}] - L_{S2} + P_1S_{1E}(1 + r_P) \quad (A.3.45)$$

$$P_2R_{2E} = \gamma W + (1 + 0.67i_d)L_{S1} \quad (A.3.46)$$

$$P_2R^P_{2S1} = (1 + 0.33i_d)[L_{S2} - L_{S1}(1 + 0.33i_l)] \quad (A.3.47)$$

$$R_{2S1} = RP_{2S1} + a \quad (A.3.48)$$

$$R_{2S2} = a \quad (A.3.49)$$

Appendix B. Individual consumption and savings decisions

All individuals have the same utility function, but different constraints depending on their occupations. We present here the consumption and savings decisions for the home producer. The decisions for other groups are similar and have the same solutions.

The home producer's decision problem is:

$$max_{C_{1HP}} U_{HP} = C_{1HP} + \theta R_{2HP}$$

subject to the constraints:

$$R_{1HP} = C_{1HP} + S_{1HP}$$

$$x_{1HP} = al_1$$

$$P_1 S_{1HP}(1 + i_d)/P_2 + x_{1HP} = R_{2HP}$$

$$l_1 = 1$$

$$c_0 R_{1HP} \leq C_{1HP} \leq R_{1HP}$$

where C_{1HP} is period 1 consumption; R_{2HP} is resources available (for allocation) at the beginning of period 2; θ is the time preference parameter; R_{1HP} is endowment at the beginning of period 1; $P_1$and P_2 are price of good X at the beginning of period 1 and at the beginning of period 2, respectively; l_1 is labor endowment in period 1; c_0 is the minimum proportion of endowment that needs to be consumed to live a period.

Substituting the constraints to the utility function and simplifying, we obtain:

$$U_{HP} = R_{1HP} + [\theta P_1(1 + i_d)/P_2 - 1]S_{1HP}$$

If $\theta(1 + i_d)(P_1/P_2) - 1 > 0$, or equivalently, $i_d > (P_2/P_1 - \theta)/\theta$, U_{HP} is maximized when S_{1HP} is the largest. That is, the optimal consumption and savings are:

$$C^*_{1HP} = c_0 R_{1HP}$$

$$S^*_{1HP} = (1 - c_0)R_{1HP}$$

If $i_d < (P_2/P_1 - \theta)/\theta$, U_{HP} is maximized when S_{1HP} is the smallest. That is, the optimal consumption and savings are:

$$C^*_{1HP} = R_{1HP}$$

$$S^*_{1HP} = 0$$