An "Austrian" Theory of Supply Chains.
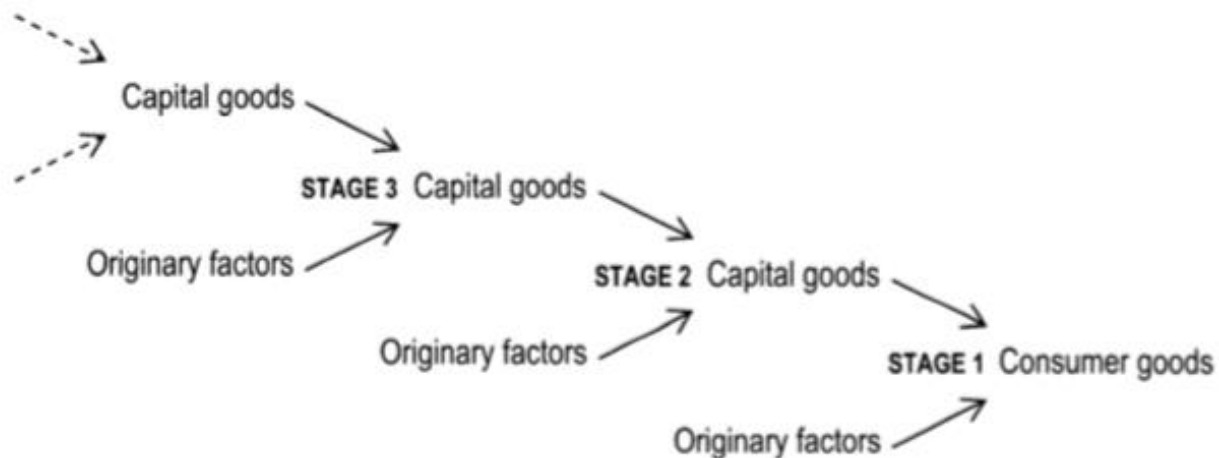
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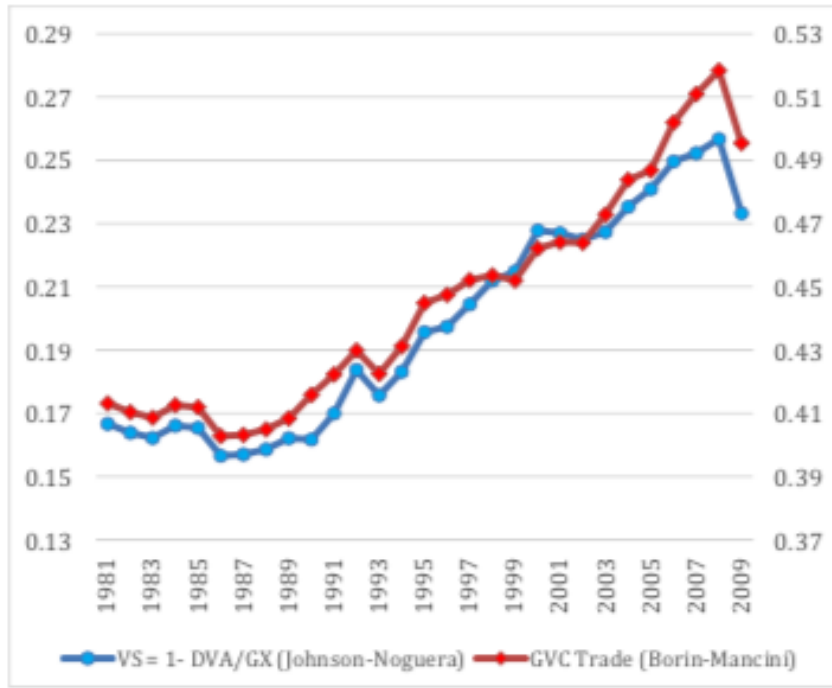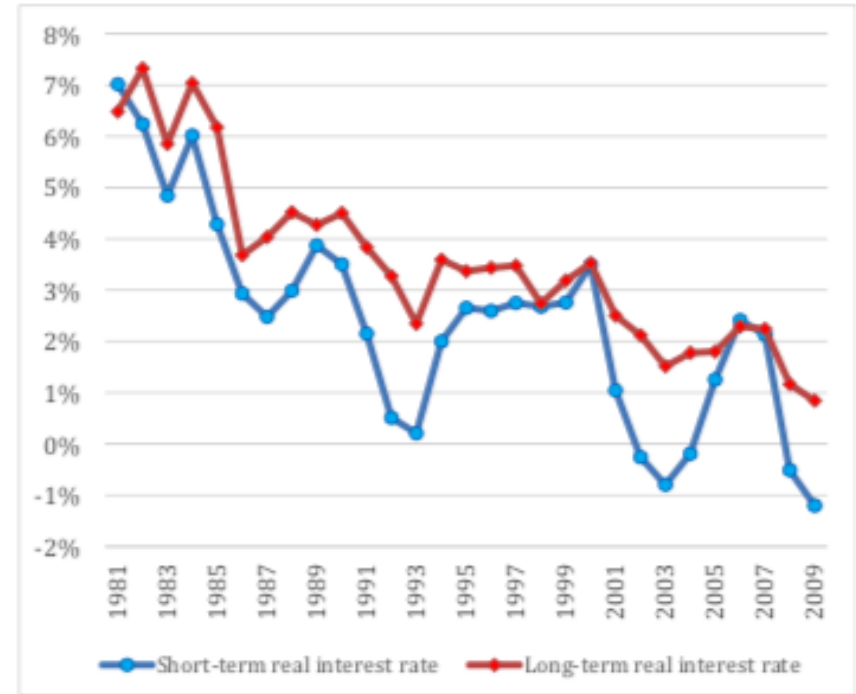School of International Studies

01 Introduction

The stages of a structure of production

An "Austrian" Theory of Supply Chains

01 Introduction

Rising GVC Participation

Declining Real Interest Rate

Antràs (2023a)

An "Austrian" Theory of Supply Chains

01 Introduction

- **In "*Interest Rates and World Trade: An "Austrian" Perspective*" (2023a), Pol Antràs:**

  - develops a framework to study the interplay between world trade and real interest rates,

    - inspired by the work of Böhm-Bawerk (1889), Wicksell (1934), and Findlay (1978), among many others.

  - The model incorporates an explicit notion of production length and of delivery time.

  - Letting the production process *mature* increases labor productivity, but it comes at the cost of higher working capital needs for firms.

  - Selling to foreign markets provides an additional source of income for firms, but exports are associated with an additional time lag between production and consumption.

  - Changes in interest rates affect production lengths, labor productivity, and the financial costs of exporting.

An "Austrian" Theory of Supply Chains

01 Introduction

- In his highly stylized "Austrian" model of international trade, a lower interest rate increases trade via four channels:

    - By increasing production length and labor productivity and thus the wage rate.

    - By increasing the propensity to consume out of labor income.

    - By reducing the additional working capital needs associated with variable costs of exporting.

    - By reducing the additional working capital needs associated with fixed costs of exporting.

- And finally suggests that if interest rates were to rise over the next few years, they could contribute to a deceleration in the growth of world trade.

An "Austrian" Theory of Supply Chains

01 Introduction

- **In "*An `Austrian' Model of Global Value Chains*" (2023b), Pol Antràs:**

  - develops a stylized model of sequential production with N stages in which the time length of each stages is endogenously determined, inspired by

    - an `Austrian' concept of capital (Jevons (1871), Böhm-Bawerk (1889), Wicksell (1934), Metzler (1950), and Findlay (1978)).

    - Sequential GVCs: Alfaro et al. (2019), Johnson and Moxnes (2019), Antràs and de Gortari (2020), Tyazhelnikov (2022), among many others.

    - Trade and Time: Deardorff (2003), Evans and Harrigan (2005), Djankov et al. (2010), Hummels and Schaur (2013).

    - Inventories, Just-in-Time: Alessandria et al. (2011), Ferrari (2022), Pisch (2022), Carreras-Valle (2022).

An "Austrian" Theory of Supply Chains

01 Introduction

- **Concludes** that 'Austrian' notion of capital has different implications for the pattern of specialization than the Clark-Samuelson notion of capital. And,

- incorporating an explicit notion of time and modeling interest rates has implications for:

  - The role of temporal trade costs in shaping specialization:

    - Insight #1: Temporal trade costs have no bearing on the length of production processes.

    - Insight #2: Temporal trade costs generate same effects as standard trade costs: Bunching of contiguous stages, less GVC activity.

    - Insight #3: Reductions in interest rates worldwide tend to increase the extent to which goods cross borders, hence generating a higher amount of 'GVC' trade.

An "Austrian" Theory of Supply Chains

01 Introduction

- The effects of trade credit and trade finance: **What if exporters/importers from low interest rate countries lend to importers/exporters in high interest rate countries?**

  - Insight #1: International trade credit expands the factor price equalization set.

    - *Per se*, this is a force toward less trade (Mundell, 1957).

  - Insight #2: Trade credit reduces the benefit of bunching contiguous stages and thus results in an increase in the share of world trade that is GVC trade:

    - *Per se*, this is a force toward more trade.

    - Overall effect of capital flows on trade flows is ambiguous.

  - Insight #3: Trade Finance (i.e., borrowing and lending related to trade costs, not production costs) generates effects analogous to combination of trade credit and trade cost reductions.

An "Austrian" Theory of Supply Chains

01 Introduction

- Antràs (2023a,b) has breathed new life into the Austrian approach in studying global value chains: **production takes time!**

- The core concept of Austrian macroeconomics is the structure of production, which makes it possible to analyze the intertemporal dimension of an economic system and to understand aspects of equilibrium, growth, and business cycle that are neglected by usual-Keynesian and Neoclassical-macroeconomic models.

- The "Austrian" label refers to the idea of "roundabout production" in the terminology of Böhm-Bawerk (1884) and the Austrian school of capital theory, where the time dimension of production introduces an intertemporal tradeoff between the interest rate and productivity.

An "Austrian" Theory of Supply Chains

02 Austrian Structure of Production Models: A Literature Review

■ A synthetic and comparative assessment of the most basic Austrian structure of production models:

❖ **Böhm-Bawek (1889)**,

❖ **Hayek (**1936, **1941)**,

❖ **Garrison (2001)**.

An "Austrian" Theory of Supply Chains

02 Austrian Structure of Production Models: A Literature Review

- **Böhm-Bawerk (1889)** expounds his model in a chapter titled "The Rate of Interest" but his exposé was a bit simplistic in that it was based upon a single numerical example.

- **Wicksell (1893)** replaced this elementary formulation by a mathematical presentation using differential equations, and by a convenient graphical display.

- **Dorfman (1959)** improved upon the Wicksellian graphical version of the model.

- And **Fillieule (2015)** elaborate a recent and comprehensive graphical account of the model.

- The **model** rests upon two exogenous data, the quantity of capital K and the number of workers N, and upon an exogenous production function f that relates the total period of production T of the economic system to the quantity q_c of consumption goods produced per worker and per year.

  » $q_c=f(T)$

The function f is increasing, which expresses a central tenet of Böhm-Bawerk's theory of capital, namely that "roundaboutness" is productive: a "well-chosen" more roundabout method of production produces more consumption goods per period, everything else equal (Böhm-Bawerk [1889] 1959, 82–84).
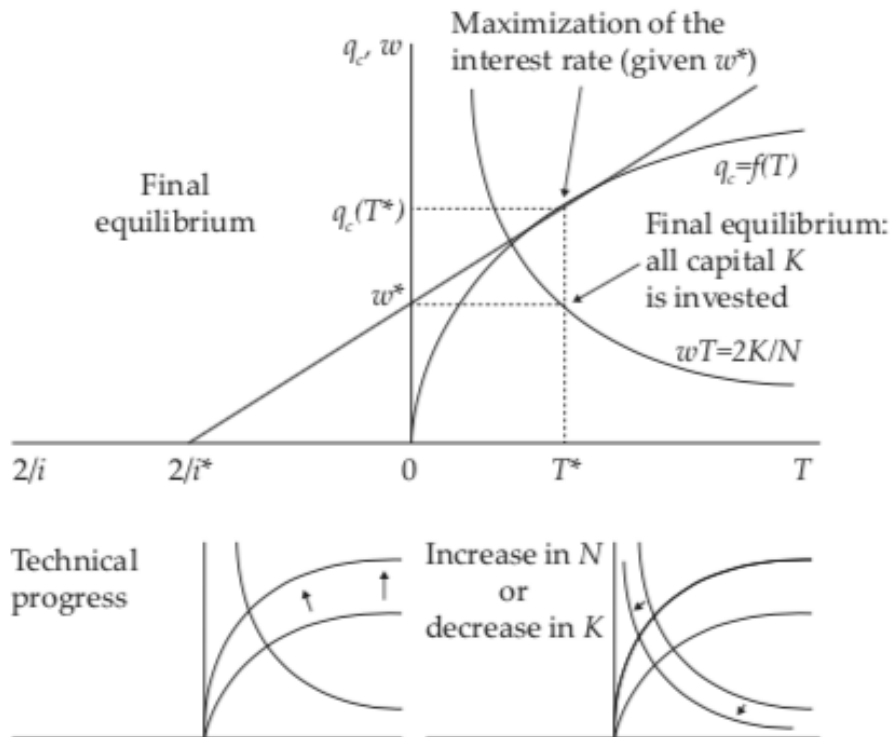
In other words, if T increases, then the annual product per worker q_c increases. This increase occurs with diminishing returns that Böhm-Bawerk justifies as an "observation… based on experience" (p. 83)

An "Austrian" Theory of Supply Chains

02 Austrian Structure of Production Models: A Literature Review

A summary of Böhm-Bawek's model	
Exogenous data	*f* production function *K* quantity of capital *N* number of workers
Endogenous variables	*i* interest rate *w* real wage *T* period of production
Causal relationship	(*f, K, N*) => (*i, w, T*)
Increase in *K* (lower time preference)	*Endogenous effects: i*<, w*>, T*>* *Distributional effects:* *- real individual wage w*>* *- real aggregate interest Π* = i*K>or<*

| A summary of Böhm-Bawek's model	
Technical progress	Endogenous effects: i*>, w*>, T*< Distributional effects: - real individual wage w*> - real aggregate interest Π* = i*K >
Increase in N	Endogenous effects: i*>, w*<, T*< Distributional effects: - real individual wage w*< (if the division of labor intensifies, it may be that w*>) - real aggregate interest Π* = i*K >

An "Austrian" Theory of Supply Chains

02 Austrian Structure of Production Models: A Literature Review

- **Hayek's model** (1941) is inspired, not by the theoretical insights elaborated by Böhm-Bawerk's contribution, but rather by the theory of interest developed by the neoclassical economist Irving Fisher (1930).

- The main purpose of Hayek with his model is to investigate the question of the determining principle of interest: **time preference or productivity?**

- He concludes that productivity is the key factor.

At the starting point Q_0 the economic system produces the quantity Q_0 of consumption goods in the current period (as shown on the horizontal axis: current output) and Q_0 in each future period (as shown on the vertical axis).
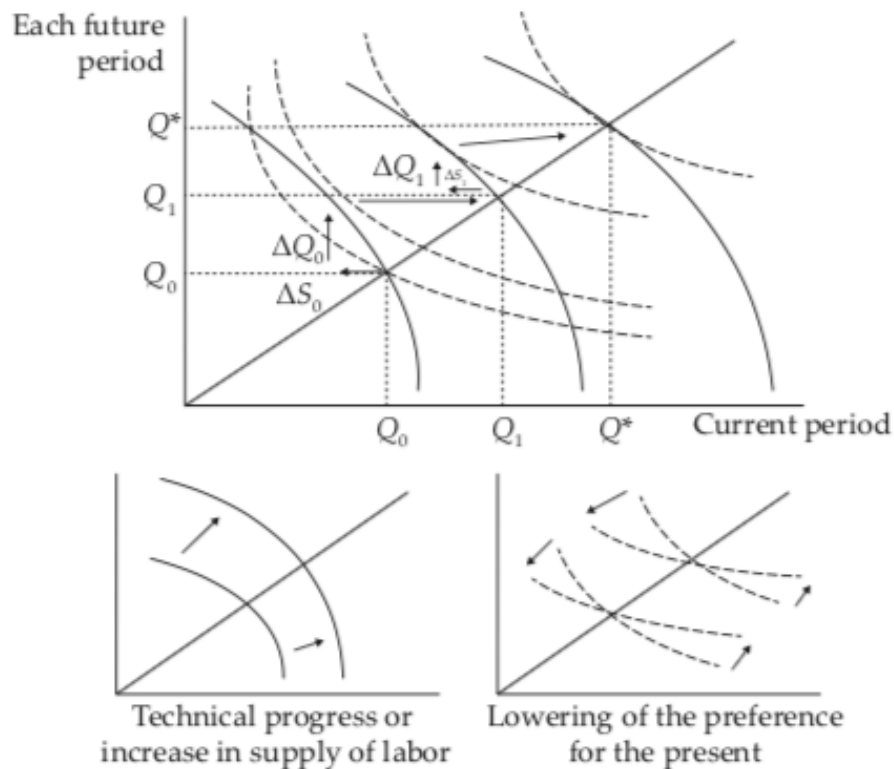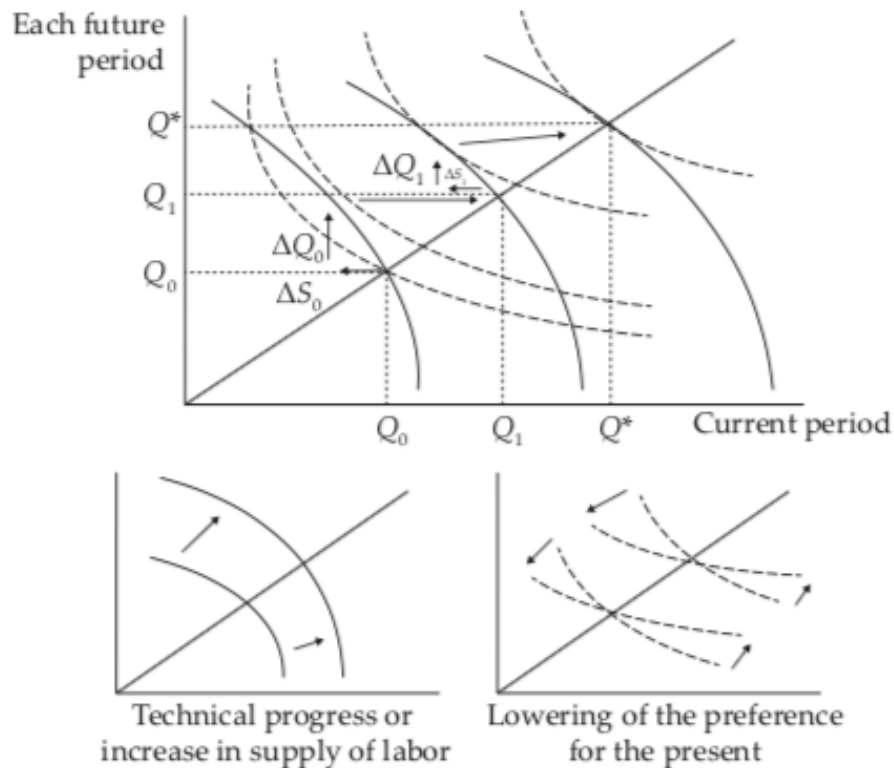

The concave curve going through Q_0 is the productivity curve, showing the additional output that can be obtained in each future period against the corresponding additional amount of present saving. The convex dotted lines are the intertemporal indifference curves.

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When the economic system is at the starting point Q_0, the actors maximize their intertemporal satisfaction—reach the highest possible indifference curve—by saving ΔS_0 and getting ΔQ_0 additional final product in each future period.

Each future period

Q^*

Q_1

ΔQ_1 ΔS_1

Q_0

ΔQ_0

ΔS_0

Q_0 Q_1 Q^* Current period

Technical progress or increase in supply of labor

Lowering of the preference for the present

In the next period, Q_1, and once again the actors maximize their intertemporal satisfaction, this time through saving ΔS_1 and getting ΔQ_1 additional final product in each future period. This process goes on period after period, until the system finally reaches the equilibrium point Q^*: the actors cannot improve their intertemporal satisfaction.

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An "Austrian" Theory of Supply Chains

02 Austrian Structure of Production Models: A Literature Review

A summary of Hayek's model	
Exogenous data	*PC productivity curve* *IC intertemporal indifference curves* *N number of workers*
Endogenous variables	*i interest rate* *K quantity of capital (implicit)* *W aggregate real wage (implicit)*
Causal relationship	*(PC, IC, N) => (i, K, W)*
Lowering of time preference Technical progress Increase in N	*All three typical changes have the same effects: i*<, K*>* *Distributional effects:* *- real aggregate interest: Π*>(generally)* *- real aggregate wage: W*>or<*

An "Austrian" Theory of Supply Chains

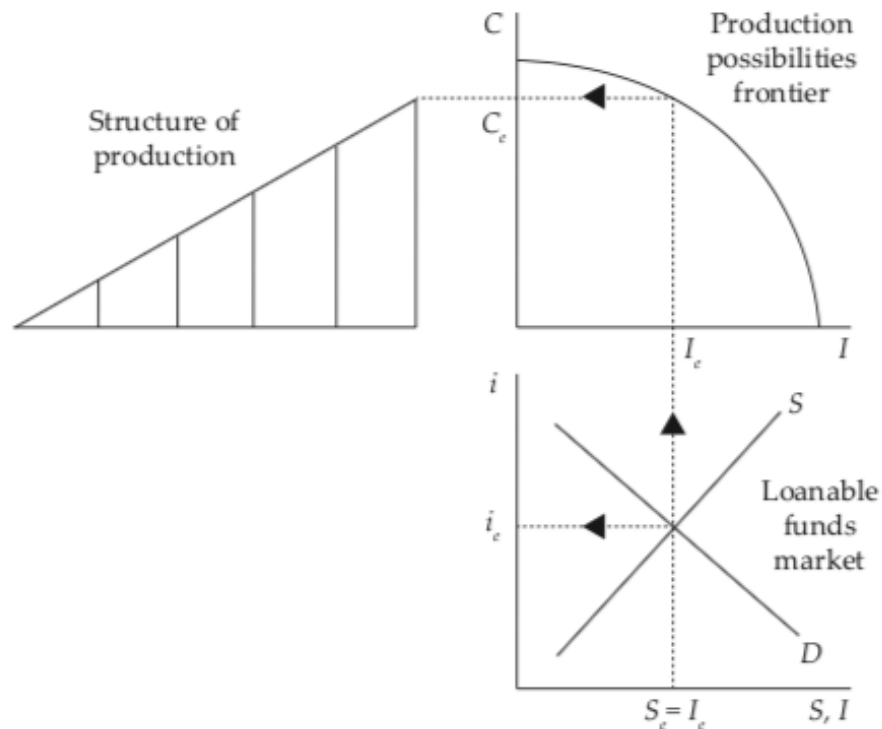## 02 Austrian Structure of Production Models: A Literature Review

- The models of Böhm-Bawerk and of Hayek rest upon an optimization process.

- **Garrison's model** (2001) rests upon the equalization between a supply and a demand.

- Here, equilibrium is determined on a generalized loanable funds market.

- The intersection of the supply of and demand for loanable funds displays the equilibrium values of the interest rate and of the gross investment spending.

- These values are used to determine the shape of a Hayekian structure of production, using the production possibilities frontier (PPF) of the economic system.

- This frontier indicates the "fundamental trade-off between consumer goods and capital goods" (Garrison 2001, 41): a greater investment during the current period requires a lower consumption, and a lower investment allows for a greater current consumption.

An "Austrian" Theory of Supply Chains

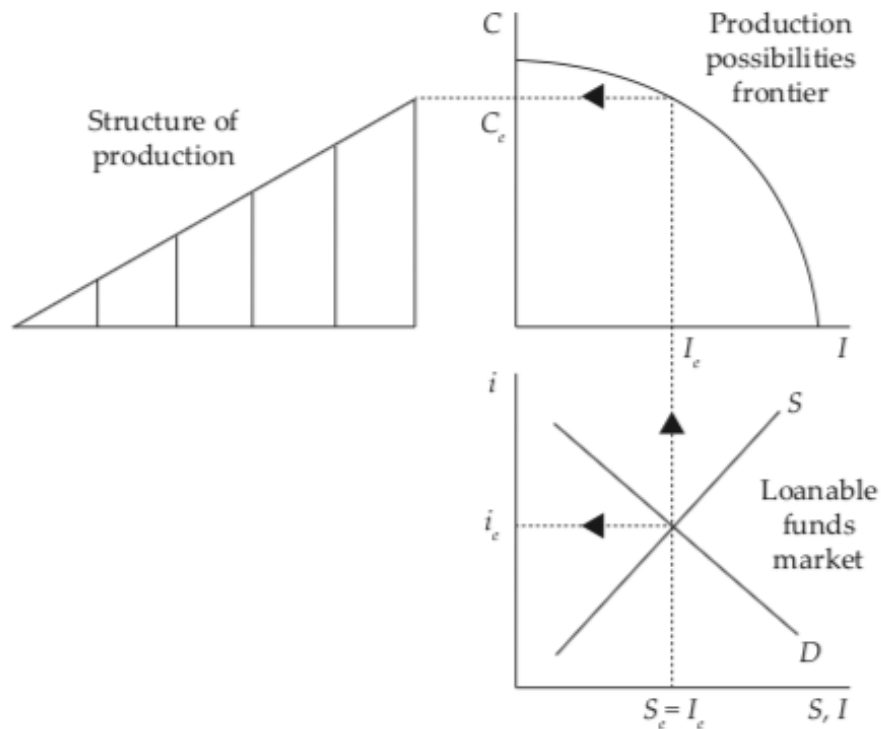## 02 Austrian Structure of Production Models: A Literature Review

The changes analyzed (i) a technical progress and (ii) a lowering of time preference.

If this progress "affects all stages of production directly and proportionally," then *I*, *output*, *income*, *C*, and *S* would all rise together without putting pressure on the *rate of interest*" (2001, 58).

If the **technical improvement** "is usable only in one or a few stages", then the interest rate is impacted: first, the demand for loanable funds increases and the interest rate rises, as entrepreneurs "seek to take advantage of the new technology"; then, as incomes increase due to the enlarged investment, the supply of loanable funds also increases, and the interest rate falls; equilibrium aggregate investment i_e necessarily rises, but the resulting effect on the equilibrium interest rate i_e is indeterminate since the effects of a higher demand for and a higher supply of loanable funds balance one another.
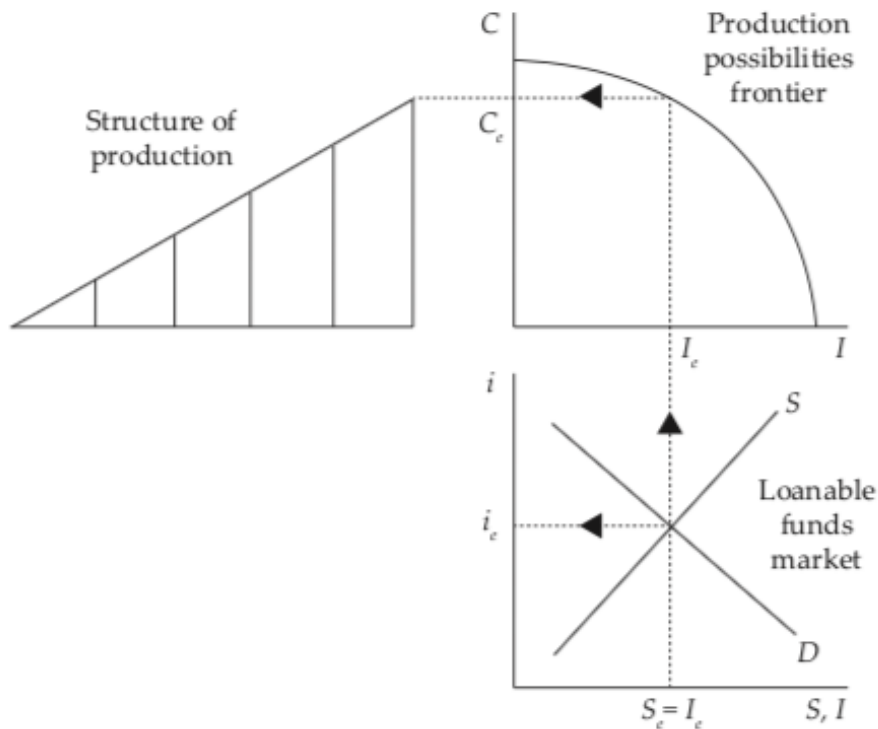
Simultaneously, the PPF shifts outward since the economic system has become more productive, so that the amount of final consumption and the period of production also rise.

In the case of a lowering of time preference: the supply of loanable funds shifts to the right, since people are willing to lend and invest more, but the demand does not move. Therefore, the equilibrium interest rate diminishes, equilibrium investment increases, consumption falls, and the structure of production becomes more roundabout.

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An "Austrian" Theory of Supply Chains

02 Austrian Structure of Production Models: A Literature Review

A summary of Garrison's model	
Exogenous data	S&D supply of and demand for loanable funds PPF production possibilities frontier
Endogenous variables	*i interest rate* *I aggregate investment* *C aggregate consumption* *T length of the structure of production*
Causal relationship	*(S&D, PPF) => (i, I, C, T)*
Lowering of time preference	*Endogenous effects: $i_e <$, $I_e >$, $C_e <$, $T_e >$* *Distributional effects:* *- real aggregate interest $\Pi_e >$ or $<$* *- real aggregate wage $W_e >$ or $<$*

A summary of Garrison's model	
Technical progress	*Endogenous effects: $i_e >$or$<$, $I_e >$, $C_e >$, $T_e >$* *Distributional effects:* *- real aggregate interest $\Pi_e >$ or $<$* *- real aggregate wage $W_e >$ or $<$*
Increase in N	-

An "Austrian" Theory of Supply Chains

02 Austrian Structure of Production Models: A Literature Review

The "Productivity" Models (Böhm-Bawerk & Hayek)

The **Intertemporal choice**: In the two models, the economic agents make intertemporal decisions, but not at all the same kind.

Böhm-Bawerk's rests upon a "*pseudo*" intertemporal choice: the capitalists choose the highest interest that they can get at the end of each period, while their investment at the beginning of this period is fixed. This means that they do not choose between present and future goods, but rather *between future goods* available at the same moment (at the end of the period): at this moment, the capitalists can get more or can get less, and choose more over less.	Hayek's model is built upon a "*genuine*" intertemporal choice: The actors face a trade-off between present and future consumption. If they want to consume more now, they must decumulate capital, and the less capitalistic structure will provide a smaller output and consumption in the future. Hayek's model offers a much more appropriate formalization of intertemporal choice.

The "Productivity" Models (Böhm-Bawerk & Hayek)

The **roundaboutness of the production process**: The period of production is a pillar of the Austrian theory of capital, according to which capital accumulation takes place through a lengthening of the structure of production.

The period of production is a pillar of the Austrian theory of capital, according to which capital accumulation takes place through a lengthening of the structure of production.
Böhm-Bawerk's model explicitly takes this length T into account as an endogenous variable.

The "roundaboutness" is not applicable in the framework of Hayek. The reason is that in his model "there is only one possible period of investment" (1941, 221), and therefore there cannot be any change in the duration of the period of production: capital accumulation takes place laterally, through the addition of similar processes of identical length, not longitudinally. His model indeed requires that, when an extra saving is invested, the increase in the production of consumption goods occurs in the very next period.

An "Austrian" Theory of Supply Chains

02 Austrian Structure of Production Models: A Literature Review

- The first and most obvious remark is that the three models are inconsistent with each other.

    - In the case of the implementation of technical progress, for instance, Böhm-Bawerk's model concludes that the interest rate will rise, while according to Hayek's model it will rise first and then fall more than it has risen (under the assumption that time preference diminishes with wealth), and in Garrison's model it can either rise or fall.

    - In the case of a lowering of the preference for the present, all the models conclude that the interest rate falls, and that investment necessarily increases.

- However, even when the conclusions converge, they are deduced from

■ The second remark is that:

  ❖ the Böhm-Bawerk and Hayek models are well suited for the study of changes that affect the real output, such as technical progress and an increase in the supply of labor: suffices to move the productivity curve and investigate the ensuing convergence process. And

  ❖ the model of Garrison is especially appropriate for the study of lending and borrowing.

An "Austrian" Theory of Supply Chains

03 Intuitions

- Inventories in transit reflect the choice in working capital necessary to set up and sustain global supply chains.

- Financing of working capital as a determinant of supply chain length.

- Formalizing this intuitions is not straightforward. It requires answer some key questions:

  - Are the "productivity" models able to integrate the phenomenon of lending and borrowing?

    - Based on Fillieule (2019): **Not!**

    - Based on Cachanosky (2021): **Yes!** Macaulay (1938): Duration (D) is a measure that captures what it was that the Austrians struggled to express over many years in their capital-theory:

      - A financial capital-based theory! (Lewin 2014, 2016, 2018, 2020 and 2021)

  - What is the relationship between bank liquidity and the structure of production?

An "Austrian" Theory of Supply Chains

04 Objectives

■ To develop a revised analysis, based on Fillieule (2005, 2007) and Hülsmann (2010), of the relationship between savings, investment, the interest rate, and the length of the structure of production. And elaborate:

❖ a systematic method for the calculation the structure of production,

❖ a series of mathematical formulas that relate the main macroeconomic variables (consumption and investment spending, interest rate, aggregate income of originary factors), and

❖ a formula for the average length of the Average Period of Production.

An "Austrian" Theory of Supply Chains

04 Objectives

- This framework will then be applied to discuss Kim & Song (2023) **propositions**:

  - ❖ **P1**: A higher interest rate r is associated with (1) lower offshoring, (2) lower productivity per worker, (3) lower output, (4) lower trade-output ratio, and (5) lower inventories in transit as fraction of output.

  - ❖ **P2**: A negative shock in the banking sector credit supply is associated with (1) an increase in the borrowing rate r, (2) fall in productivity per worker, (3) fall in output, (4) fall in the inventories in transit, and (5) fall in the trade to output ratio.

Thanks!

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