Research Article

Nicolas Piluso*

Asymmetrical Monetary Relations and Involuntary Unemployment in a General Equilibrium Model

https://doi.org/10.1515/econ-2022-0125
received June 26, 2024; accepted September 22, 2024

Abstract: This article aims to model Keynesian involuntary unemployment within the framework of Walrasian general equilibrium, incorporating an additional hypothesis: the possibility of credit restrictions by banks or financial intermediaries. Keynes's theory of involuntary unemployment is based on the rejection of the "second classical postulate," which leads to the idea that entrepreneurs alone decide the level of employment. This is what some Keynesians call the asymmetry of the wage relationship. The result is a restriction of Walras' law, which no longer includes the labor market. However, the problem is that entrepreneurs themselves may find themselves constrained by financial intermediaries. If there is a second type of asymmetry, i.e., between banks/financial intermediaries and entrepreneurs, Walras' law will be doubly restricted since it will also exclude the credit market. I set out to identify the consequences of the properties of involuntary unemployment in a general equilibrium model.

Keywords: unemployment, wage, credit constraint, general equilibrium, Walras's law

JEL classification: B22, C39, E24, D50

The various economic crises experienced by developed countries have shown the extent to which credit rationing can lead to a slowdown or even a decline in economic activity.

The neo-Keynesian literature understands this phenomenon of rationing as the consequence of asymmetric information between lenders and borrowers. The seminal articles by Stiglitz and Weiss (1981), Bernanke and Getler (1989), Blinder, 1987 and, more empirically, Kashyap et al. (1994) are just a few examples. Following this tradition, Cherif (1999) shows that in the absence of knowledge of the probability of a borrower defaulting, banks are led to raise their interest rates. In so doing, they tend to attract borrowers with high-risk projects (the phenomenon of adverse selection) or to encourage borrowers, once the credit contract has been signed, to take greater risks in order to increase the profitability of the investment in the event of success (the phenomenon of moral hazard). It is in this theoretical context of information asymmetries that Gathak et al. (2002) and Kojima (2009) identify the phenomenon of credit rationing. There are also credit-restriction models in post-Keynesian theory, but in general, all prices are considered fixed (Le Héron & Mouaki, 2008; Piluso, 2019; Toussaint Armel, 2015).

In this article, I argue that such an imbalance in the credit market can be formalized in an alternative way. The relationship between "industrial capital," represented by non-financial companies, and "financial capital," held by banks and financial intermediaries, can be considered asymmetrical. This asymmetry characterizes the fact that when the effective interest rate is lower than the equilibrium interest rate, it is the banks that unilaterally set the amount of credit to be granted to companies. The intuition behind this research is that taking this crucial aspect into account is decisive in Keynes's analysis of involuntary unemployment. Indeed, we shall see that in a situation of credit rationing, the traditional wage–employment relationship is substantially amended.

Keynes builds a new theory of production and employment by rejecting the "second classical postulate," according to which the wage-earner has the capacity to arbitrate between work and leisure in order to maximize his utility (Cartelier, 1996). According to Keynes, in a situation of involuntary unemployment, wage earners are subordinated to the decisions of entrepreneurs and have no possibility of situating themselves on their labor supply curve. This is what Cartelier (1996) calls the asymmetry hypothesis between entrepreneurs and wage-earners. On the basis of this hypothesis, Keynes presents the principle of effectiveness. Entrepreneurs set the

* **Corresponding author: Nicolas Piluso,** Habilitation to Supervise Research, Toulouse Paul Sabatier University (France), CERTOP CNRS, 115E Rte de Narbonne, 31000 Toulouse, France,
e-mail: nicolas.piluso@iut-tlse3.fr, nicolas.piluso@orange.fr,
tel: +33-0631789651

level of production and employment that allows them to maximize their expected profits.

Our framework is that of general equilibrium theory. Indeed, it is in this context that Cartelier (1995, 2018), Glustoff (1968), and Piluso and Colletis (2021) have modeled Keynes's theory of unemployment to demonstrate that the latter is not based on assumptions of fixed prices or imperfect competition. However, from the point of view of the Keynesian project, the four economists' model is flawed in that it shows unemployment declining as nominal wages fall. Using an analytical framework drawing on Cartelier and Glustoff, I therefore wish to show that, under certain circumstances, unemployment does not decline, even when competition and price flexibility are perfect.

The results of numerous empirical studies demonstrate the need to theoretically demonstrate the absence of any significant effect of nominal wage variations on the volume of employment, in line with the Keynesian project. For instance, Card and Krueger (1994) show that raising the minimum wage has no negative impact on employment. To do this, they compare the situation in the fast-food sector in two American states with similar socio-economic characteristics: New Jersey (where the minimum wage increased by 18% in 1992) and Pennsylvania (where the minimum wage remained stable). They found that the increase in the minimum wage had no negative effect on employment in New Jersey. Azar's empirical study (2024) shows that a rise in wages has a different effect depending on the level of concentration in the labor market. But in all cases, the effect is weak, whether positive or negative. The effect of wage increases on employment is also neutral in the studies of Cengiz et al. (2019) and Clemens and Wither (2019). Standard theoretical approaches are generally unable to explain these results since even in new labor market theories, unemployment is explained by a real wage or a nominal wage that is both rigid and too high (Block and Galabuzi (2022), Kara, 2024; Layard et al., 1991; Ray, 2024; Zhou, 2023).

While the problem of credit rationing is borrowed from the analysis of the neo-Keynesians, I aim to develop an alternative model in which competition is perfect. There will be no question of asymmetric information or real price rigidity. Furthermore, even if I assume that a certain number of prices are parametric, the market price of the consumer good is perfectly flexible. Consequently, if this market is considered representative of the functioning of n goods markets, this means that the prices of goods on these n markets are flexible. The analysis developed in this article is therefore neither neo-Keynesian (which assumes, among other things, imperfect information) nor disequilibrium theory (which assumes that *all* prices are fixed).[1] Our approach is in line with the theoretical approach taken by Glustoff (1968), Cartelier[2] (1995, 2018), and Piluso and Colletis (2021), who highlight status asymmetries between economic agents.

After reiterating the originality of Cartelier's model, (1) the choice of credit rationing model will be explained. (2) The presentation of a new model of involuntary unemployment will show that the level of unemployment is insensitive to the fall in nominal wages. This result makes it possible to see under which conditions it is possible to answer Keynes's problem, which is to show that an involuntary unemployment equilibrium can exist even when prices and wages are flexible.

1 Reviewing Cartelier's Model (1995, 2018)

The purpose of this section is to reiterate that Glustoff's result leads to the elimination of the role of real rigidities in unemployment theory. This is a particularly important result since labor market theories frequently emphasize rigidities or imperfections in the labor market (Cahuc & Zylberberg, 2004; Julien & Sanz, 2005). The general principles of Glustoff's model will therefore be presented, following the method adopted by Cartelier in his 1995 and 2018 books.[3]

Let us consider a firm that produces a good for consumption and investment and a household that consumes the good and offers its labor. Suppose the household maximizes its utility under the constraint of the firm's demand for labor, not its supply of labor. Its budget constraint is written as follows:

$$C + (1/i)B^{\mathrm{d}} \leq (w/p)L^{\mathrm{d}}, \tag{1}$$

with C being the consumption of the good, B^{d} the demand for the securities that enable it to invest its savings, i the interest rate on each security, w/p the real wage rate, and L^{d} the demand for labor from the firm. We see here that the household budget constraint is under the control of the firm's demand for labor. In fact, it is assumed that there is

1 Malinvaud (1980) presented the theory of disequilibrium.

2 According to Cartelier (1995), the asymmetry of the wage ratio and the fixity of nominal wages do not call into question the perfection of competition. Economic agents remain price takers, information remains perfect, products are homogeneous, factors of production remain mobile and free market entry is respected. Moreover, real prices can adjust freely.

3 A modeling method relatively similar to Cartelier's is used by Julien (2004) and Piluso and Colletis (2021).

a status asymmetry between entrepreneurs and employees: the former unilaterally determines the employment level of the latter from the moment when real wages are above their equilibrium level.

Maximizing household utility under this constraint gives the following consumption and securities demand functions:

$$C^{d} = C^{d}(1/i, w/p, L^{d})$$
$$B^{d} = B^{d}(1/i, w/p, L^{d}).$$

The firm's budget constraint is written as follows:

$$Y^{s} + B^{s}(1/i) = I^{d} + (w/p)L^{d}, \tag{2}$$

with Y^{s} being the supply of goods, I^{d} the demand for goods for investment, and B^{s} the supply of securities to finance the investment.

The firm's supply and demand functions are written as follows:

$$I^{d} = I^{d}(w/p, 1/i),$$
$$B^{s} = B^{s}(w/p, 1/i, L^{d}),$$
$$Y^{s} = F(L^{d}, \overline{K}),$$
$$L^{d} = L^{d}(w/p).$$

The general equilibrium of this economy is written as follows:

$$\begin{aligned} &L^{d} - L^{s} = 0 \\ &C(1/i, w/p, L^{d}) + I^{d}(1/i, w/p) - F(L^{d}, \overline{K}) = 0 \\ &B^{d}(1/i, w/p, L^{d}) - B^{s}(1/i, w/p, L^{d}) = 0. \end{aligned} \tag{3}$$

This system does not fully satisfy Walras's law, as the labor market is not part of it. This can be verified by summing budget constraints (1) and (2):

$$(1) + (2):\ C + (1/i)B^{d} + I^{d} + (w/p)L^{d} = (w/p)L^{d} + Y^{s} + B^{s}(1/i),$$

which gives

$$[C^{d} + I^{d} - y^{s}] + (1/i)[B^{d}(.) - B^{s}(.)] = 0.$$

As a result, the economy can be said to be in equilibrium in all markets except the labor market. This restriction of Walras' law stems from the fact that, in the event of involuntary unemployment, the value of the supply of labor does not influence the demand for goods expressed by the worker. There is a *continuum* of involuntary unemployment equilibria set by the nominal wage.

The question is how price flexibility can prevent the restoration of equilibrium in the labor market. As far as the variation in the price of the good is concerned, which is likely to vary the real wage rate, the answer is contained in Walras' restricted law. Insofar as the market for the good is perfectly balanced, there is no reason for the price to vary. Conversely, it is possible to think that a disequilibrium in the labor market could lead to a variation in nominal wages, allowing the real wage rate to return to its equilibrium value. It should be pointed out that both Glustoff and Cartelier assume that wages are rigid below a certain value. It is not wage rigidity that gives rise to the possibility of involuntary unemployment since it would be of no consequence in Walras' model. On the contrary, it is wage rigidity that ensures the stability of such unemployment: "This is where Keynes's assumption of nominal wage rigidity comes into its own. While the system admits the Walrasian equilibrium (without involuntary unemployment) as its only static solution, it is possible to show that adjustment towards this equilibrium can be prevented and that there are an infinite number of dynamic equilibria, only one of which corresponds to the absence of involuntary unemployment" (Cartelier, 1995, p. 51).

The models proposed by Glustoff and Cartelier (2018) thus have the merit of reminding us, as per Keynes, that no outcome of involuntary unemployment can occur as long as Walras' law has not been violated. From the second chapter of his *General Theory* onwards, Keynes rejects the second classical postulate, according to which wage earners have the possibility of adjusting the marginal disutility of the volume of employment to the real wage rate. In his view, it is equivalent to positing the possibility of involuntary unemployment and rejecting Say's law (or Walras' law)[4] or the "second classical postulate." Thus, in order to introduce the possibility of involuntary unemployment, it is sufficient to violate the "second classical postulate" and thus Walras' law. There is no need to appeal to any market imperfection or invoke forecast uncertainty in order to obtain such a result. As Cartelier (2018) points out, Keynes posits such a rejection even before evoking the monetary character of the economy, the principle of effective demand, and the theory of the interest rate.[5]

4 Say's Law asserts that supply creates its own demand, which rules out the possibility of general overproduction Say (1999). Sectoral imbalances are possible, but they offset each other at the macroeconomic level, so that the economy's overall net demand is always zero. Walras' law also asserts the nullity of the sum of all budget constraints in the economy, or the sum of net demand in each market. This is why many economists equate J.B. Say's law with Walras' law.

5 Note that the rejection of Keynes' "*second classical postulate*" opens up the *possibility of the* existence of an involuntary unemployment equilibrium. What makes it possible to move from the mere possibility to an *actual* unemployment equilibrium is the insufficiency of production set in motion by entrepreneurs in relation to the available workforce at the prevailing wage rate.

The main limitation of this result, from the point of view of Keynes's project, lies in the fact that a nominal wage cut is likely to reduce the level of unemployment. However, following the theoretical perspective opened up by Glustoff and Cartelier, it is possible to show that a situation of credit rationing makes unemployment insensitive to such a cut. It is therefore necessary to specify how credit rationing is to be modeled.

2 Modeling Credit Rationing

In this article, I model the financial relationship using Glustoff's (1968) method applied to the wage relationship.

The first assumption adopted is that of the exogeneity of the interest rate in the banking market. This consideration has a fundamental point in common with recent models from the "new neoclassical synthesis" (Woodford, 2002) and post-Keynesian theory (Berr, 2018, Lavoie et al., 2021, Le Heron & Cottin-Euziol, 2021). In post-Keynesian theory, the interest rate is assumed to be administered by the central bank in the pure horizontalist tradition (according to which the money supply is endogenous). In dynamic and stochastic general equilibrium (DSGE) models, the interest rate is indeed endogenous, but in line with our approach, it is set by the central bank.[6] Insofar as the aim of our model is not to analyze the interaction between unemployment and central bank strategy but to account for the *existence* of involuntary unemployment in a flexible real wage situation, I consider the interest rate to be a parameter of the model.[7]

In general equilibrium theory, the fact that there is an *a priori* fixed price on the credit or financial market is not enough to generate an imbalance between supply and demand. If the nominal interest rate is fixed, the adjustment is made by the price level of the good, which leads to a change in the real interest rate. In order to account for misalignment between supply and demand for credit, we therefore need to be able to conceive that Walras' law is no longer verified, i.e., that the imbalance in the banking market coexists with an equilibrium in all other markets, including that for goods and services. Since Keynes, we have known that this implies the existence of asymmetry between agents. In the case of the banking market, its disequilibrium implies that the firm's budget constraint is subject to the banks' supply of funds: I call this substitution of capital demand by supply in firms' constraints the asymmetry between "financial capital" and entrepreneurs.

Therefore, if an imbalance in the banking market is possible, it is not so much because the interest rate is set by the Central Bank, but ultimately because it is the banks' supply that determines the amount of investment that the firm will be able to make. The credit market, from the moment I assume asymmetry between productive and financial capital, is not the place for a confrontation of supply and demand. Banks' investment decisions are sovereign. The amount of investment will therefore not correspond to the volume of capital that maximizes its profit, but to the value of the banks' supply of funds.

The entrepreneur formulates a demand for capital, but this does not play a part in determining the investment. The latter is constrained by banks' decisions.

This choice to model credit rationing is linked both to a specific theoretical position and to the aim of the article.

The theoretical position underlying the modeling is the idea that in certain markets (such as credit or labor), there is no confrontation between economic agents whose status or decision-making power is symmetrical. On the contrary, the decisions of a certain class of economic agents impose themselves on those of another. This hypothesis of asymmetrical status between agents is not simply based on that of Keynes, but also on hypotheses put forward by Marx, Smith, and Ricardo (Piluso & Cottin-Euziol, 2024). The immediate consequence of this hypothesis is that any imbalances in markets are not linked to their imperfection, but to the very nature of the economic system in which they operate. This means that certain markets are not characterized by simple exchange relations, but by subordination: between banks and entrepreneurs on the one hand and between employees and entrepreneurs on the other. The wage relationship is characterized by the subordination of employees to the decisions of entrepreneurs, who must rent out their labor factor in order to gain access to the goods market. Firms, on the other hand, are forced to take on debt in order to make the investments necessary for their production activities. When banks or financial intermediaries impose their decisions on entrepreneurs, this means that the effective interest rate is structurally lower than the equilibrium interest rate.

We find the notion of asymmetry between banks and entrepreneurs not in the General Theory, but in the Treatise on Money (1930). The latter deals with situations of credit restriction, largely ignored in General Theory. According to Keynes, banks can influence the quantity of money offered: "by varying the price and quantity of bank credits, the

6 In DSGE-type models, the central bank sets the interest rate according to a strategy similar to Taylor's rule (1993): an increase in inflation leads, all other things being equal, to a tightening of monetary policy and therefore an increase in the interest rate.

7 The introduction of a specific central bank strategy and its effects on unemployment could be the subject of a later article.

banking system regulates the value of investment … The banking system necessarily controls overall production expenditure" (p. 354); Keynes thus asserts that "in certain situations, the money supply of the banks 'does not correspond to the heavy tendency of general economic activity'" (Keynes, p. 424). Investment may be "partly determined by the rationing policy of the banking system and by its lending conditions" (p. 380).

Status asymmetries between economic agents have nothing to do with information asymmetries, which are the result of imperfections in competition. The asymmetry I have highlighted distinguishes capitalism from a simple exchange economy. However, this in no way prevents information asymmetries from being added to the Keynesian ones. One does not exclude the other. On the contrary, they are complementary. Nevertheless, I do not take information asymmetries into account in my model, as my aim is to show that the relationship between wages and employment can be modified even if the main assumptions of perfect competition are maintained.

Furthermore, this article aims to enrich the initial model by Cartelier (1995), whose originality I have outlined above. It is therefore necessary, in this perspective, to adopt the same type of model. This will enable us to assess the contribution of credit rationing to the project of demonstrating involuntary unemployment with a flexible real wage.

3 Solving an Unemployment Model with Asymmetric Financial Reporting

The model is composed of three types of agents: a representative wage-earning household (of n homogeneous households) that consumes, saves, and offers its labor, a bank acting as a financial intermediary, and two representative firms belonging to two distinct sectors (the capital production sector and the consumer goods production sector).

The firm in the first sector, of the Ricardian type, does not hire employees:[8] it produces wheat (capital good) with wheat. The second firm produces barley (a consumption good) using a combination of labor (offered by households) and wheat (capital). The behaviors of the bank, the representative household, and the firms will be successively examined to finally solve the model.

The nature of the model is similar to Cartelier's: it is an intertemporal general equilibrium model. There is a single price for each good and a market for all goods, whether present or future. Agents make their choices in the first period on all present and future goods, based on prices known today.

3.1 Bank's Behavior

Unlike Cartelier's model, the focus here is not on a financial market but on a bank credit market. In this model, the bank is seen as a financial intermediary that collects savings from households with financing capacity and lends them to economic agents in need of financing, i.e., businesses.

It is assumed that the interest rate on borrowing is identical to the interest rate on investment and is determined by the Central Bank. What distinguishes this bank credit market from the financial market in Cartelier's model is that the bank has the capacity to issue an additional supply of funds proportional to the savings collected. The proportionality coefficient, exogenous as it is governed by the central bank, is noted ω. Households, for their part, receive all the interest collected from companies, because they are shareholders in the bank.[9]

3.2 Household Behavior

When the labor market is in excess supply, in other words, when there is involuntary unemployment, the labor supply is deactivated, and it is the value of the labor demand of the representative firm in sector 2 that is found in the employee's budget constraint, taking into account the asymmetry hypothesis (Cartelier, 1995).

8 This hypothesis of a firm producing capital goods without the help of labor is intended to simplify the presentation and calculations of the model, without altering the final results.

9 The asymmetry of the financial relationship we are describing may seem contradictory to that of the wage relationship, since here households are shareholders in the banks. Nevertheless, it should be stressed that it is not the isolated holding of a security that confers economic power on its owner. It is centralized savings, as amassed by investment funds, that confer real ownership. In this respect, it seems justified to doubt the abolition of the asymmetry between entrepreneurs and employees in the light of patrimonial capitalism, in which employees become shareholders in their own companies. This legal ownership by employees does not give them any real individual economic power. Furthermore, the separation of shareholders and households in the model, assuming that shareholders' savings decisions determine investment, adds nothing and does not alter our final result. As a principle of economics, we consider that the shareholder and the employee are one and the same entity.

The consumer/worker maximization program is as follows:

$$\text{Max.} U(C, B^{\text{d}}) = a \ln C + b \ln B^{\text{d}}$$
$$C, B^{\text{d}},$$

under duress: $wL^{\text{d}} = pC + (p/i)(1 + \omega)B^{\text{d}}$,
where C represents the consumption of the salaried household, B^{d} is its demand for a bond, w designates the nominal wage, and L^{d} the demand for labor. I define and model the bond as Cartelier (1995) presents it, namely as "an entitlement to a unit of good in all subsequent periods" (p. 42).[10] Parameter b measures the relationship between the level of savings offered and household utility. The greater the parameter, the more likely the household is to save. Finally, ω represents the proportion of loanable funds issued by the second-tier bank. These loanable funds are never more than a certain number of additional rights on future consumption. The household recovers the interest.

As a consequence, the utility function indicates that the household makes a choice between present consumption and savings, i.e., between present consumption and future consumption. This type of modeling can be found in Cartelier (1995, 1996) and Ludovic (2004).[11]

Solving the above program yields the following household demand functions:

$$C = \frac{a}{a + b + 1}\frac{w}{p}L^{\text{d}}, \tag{4}$$

$$B^{\text{d}} = \frac{b}{b + a + 1}\frac{w}{p}(1 + \omega)(i)L^{\text{d}}. \tag{5}$$

3.3 Behavior of the Firm in the First Sector (Capital Production)

It produces wheat with its own wheat, whose quantity is denoted by G and whose parametric price is called r. Its profit maximization program π_b can be written as follows:

Max $\pi_b = rF(G) - rG$ under duress: $F(G) = \lambda G^{\mu}$.

The wheat demand function G_b of the firm in sector 1 can be deduced from the following:

$$G_b = \left[\frac{1}{\mu\lambda}\right]^{\frac{1}{\mu-1}}. \tag{6}$$

Its wheat supply function Y_b is therefore:

$$Y_b = \lambda\left[\frac{1}{\mu\lambda}\right]^{\frac{\mu}{\mu-1}}. \tag{7}$$

3.4 Behavior of the Firm in the Second Sector (Production of the Consumer Good)

The production function of the firm in sector 2 is written as follows:

$$Y^{\text{s}} = f(L, K) = AL^{\alpha}K^{\beta} \text{ with } \alpha < 1, \ \beta < 1,$$

with Y^{s} being the output (here, barley) and L and K the labor and capital factors (wheat), respectively, and A is the productivity parameter. In line with our double asymmetry hypothesis, I assume that the firm's demand for capital is deactivated and that it is the value of household demand for securities that is included in firm 2's budget and technology constraint. Furthermore, the firm expresses its demand for physical capital K to the firm in sector 1. Since the price of wheat is r, the sector 2 firm pays rK to sector 1. To finance this demand for capital, the firm submits an offer of securities on the financial market B^{s}, which meets the bank's offer of funds $B^{\text{d}}(1 + \omega)$.[12] If the interest rate set by the central bank is below its equilibrium level, we have, given the assumption of financial asymmetry:

$$rK = B^{\text{d}}(1 + \omega), \tag{8}$$

hence

$$K = \frac{1}{r}B^{\text{d}}(1 + \omega). \tag{8'}$$

Firm 2's maximization program is written here:

$$\text{Max.}\pi = pY^{\text{s}} - wL^{\text{d}} - i(rK)$$
$$L^{\text{d}}$$

under duress $Y^{\text{s}} = AL^{\alpha}K^{\beta} = AL^{\alpha}((1/r)B^{\text{d}}(1 + \omega))^{\beta}$.

This gives us the following labor demand function:

$$L^{\text{d}} = \left(\frac{\alpha A((1/r)B^{\text{d}}(1 + \omega))^{\beta}}{w/p}\right)^{\frac{1}{1-\alpha}}. \tag{9}$$

10 It is assumed to be a perpetual bond, so the income from the asset is 1/i.

11 The nature of the utility function has no impact on the final result of the model, which is the modification of the usual relationship between wages and employment. It would have been possible to use, for example, a CES utility function, but this would only make the resolution of the model more complex.

12 The presence of the parameter ω in the model does not alter the final result of the model (the nature of the wage-employment relationship). It merely modulates the level of involuntary unemployment.

Walras' law is now restricted to the markets for goods (barley) and physical capital (wheat). The sum of budget constraints gives

$$w/p(L_{\mathrm{d}} - L_{\mathrm{d}}) + i/p(B^{\mathrm{d}}(1+\omega) - B^{\mathrm{d}}(1+\omega)) + p(Y^{\mathrm{s}} - C) + r(Y_b - G_b + K) = 0,$$

hence, $p(Y^{\mathrm{s}} - C) + r(Y_b - G_b + K) = 0$.

According to the corollary of Walras' law, if the market for the good is in equilibrium, then so is the market for capital (wheat). The general equilibrium of the economy can therefore be given by the equation:

$$C = Y^{\mathrm{s}},$$

which is still written as follows:

$$\left(\frac{a}{a+b+1}\frac{w}{p}L^{\mathrm{d}}\right) = A(L^{\mathrm{d}})^{\alpha}((1/r)(1+\omega)B^{\mathrm{d}})^{\beta}. \qquad (10)$$

Since the investment function (demand for capital) is deactivated, it is the demand for securities that figures in the equilibrium equation of the market for the good. The system consists of a single equation for three unknowns; the variables to be determined are the demand for securities B^{d}, the demand for labor L^{d}, and the real wage w/p. The demand for securities and the demand for labor are then parameterized by the interest rate, the price of physical capital r, and the nominal wage. This is what I now set out to verify.

3.5 Solving the Model: Involuntary Unemployment Equilibrium with Flexible Prices and Credit Rationing

In this model, the adjustment variable for the goods market is the real wage rate, which is therefore the model's endogen. Replacing the consumer's demand for securities with its expression in the labor demand function, we obtain

$$L^{\mathrm{d}} = \left(\frac{\alpha A\left(\frac{b}{a+b+1}\right)^{\beta}(1/r)^{\beta}(1+\omega)^{\beta}(i)^{\beta}}{(w/p)^{1-\beta}}\right)^{\frac{1}{1-\alpha-\beta}}. \qquad (11)$$

Let us rewrite (11), establishing that $V = \alpha A\left(\frac{b}{a+b+1}\right)^{\beta}(1/r)^{\beta}(1+\omega)(i)^{\beta}$. We then have

$$L^{\mathrm{d}} = \left(\frac{V}{(w/p)^{1-\beta}}\right)^{\frac{1}{1-\alpha-\beta}}. \qquad (11')$$

The goods supply function is obtained by substituting L and K in the production function with their respective expressions:

$$Y^{\mathrm{s}} = A\left(\left(\frac{b}{a+b+1}\right)(1/r)(1+\omega)(i)\right)^{\frac{2\beta(1-\alpha-\beta)+1}{1-\alpha-\beta}} \times \left(\frac{w}{p}\right)^{\frac{2\beta(1-\alpha-\beta)+\alpha+\beta}{1-\alpha-\beta}}. \qquad (12)$$

To simplify, let us assume that $D = \left(\frac{b}{a+b+1}\right)(1/r)(1+\omega)(i))^{\frac{2\beta(1-\alpha-\beta)+1}{1-\alpha-\beta}}$. We can rewrite (10)

$$Y^{\mathrm{s}} = A\left(D\left(\frac{w}{p}\right)\right)^{\frac{2\beta(1-\alpha-\beta)+\alpha+\beta}{1-\alpha-\beta}}. \qquad (12')$$

The real wage compatible with goods market equilibrium is then given by the equation:

$$\left(\left(\frac{V}{(w/p)^{1-\beta}}\right)^{\frac{1}{1-\alpha-\beta}}\left(\frac{w}{p}\right)\right)E = A\left[D\left(\frac{w}{p}\right)\right]^{\frac{2\beta(1-\alpha-\beta)+\alpha+\beta}{1-\alpha-\beta}}, \qquad (13)$$

with $E = \left[\frac{a}{a+b+1}\right]$. It is a function of all the model parameters: agent preference, interest rate, and production technology. Its expression can be written as follows:

$$\frac{w}{p} = \left[\frac{A[D]^{\frac{2\beta(1-\alpha-\beta)+\alpha+\beta}{1-\alpha-\beta}}}{(V)^{\frac{1}{1-\alpha-\beta}}[E]}\right]^{\frac{\beta(1-\alpha-\beta)+\alpha+\beta}{1-\alpha-\beta}}. \qquad (14)$$

4 Discussion

Equation (14) shows that the real wage is endogenous and determined by the model parameters. Instead of stimulating demand for labor, as in Glustoff and Cartelier, the nominal wage cut only affects the price of the good, which falls by the same proportion. The nominal wage cut therefore leaves the real wage unchanged, and as a result, the level of unemployment remains constant, whatever the value of production elasticities, and as a result whatever the level of factor productivity (Appendix). What we have here is a kind of "quantitative theory" of nominal wages. *This does not mean, however, that the real wage is rigid*: it fluctuates with price variations, in line with changes in the equilibrium of the goods market.

In terms of economic policy, the results are particularly intuitive. In a situation of credit rationing, equilibrium on the goods market is achieved by adjusting the real wage rate (equation (13)). Any positive shock to the demand for consumer goods (increase in the propensity to consume, equation (4)) leads to a rise in the price of goods and therefore a fall in the real wage (equation (13)). As the real wage falls, demand for labor rises and unemployment falls (equation (11′)). In line with Keynes' analysis, it is necessary to stimulate consumption to address unemployment.[13]

I also need to act on the determinants of labor demand, namely the productivity parameter and the level of invested capital. Any increase in productivity (parameter A) or the proportion of loanable funds provided by the bank (parameter ω) increases the level of investment and therefore employment (equation (11)).

The only "non-Keynesian" result of the model concerns the effect of a variation in the interest rate. In a rationing situation, a rise in the interest rate stimulates the supply of savings and increases investment by firms.[14] This result is linked to the rationing situation. However, it is possible to substitute an increase in the interest rate with a policy of credit expansion (an increase in the ω coefficient via, for example, a reduction in reserve requirements).

Consequently, in this "Cartelier-type" model, a number of Keynesian conclusions are evident from the moment credit is rationed:

- It is ineffective to address unemployment by lowering nominal wages;
- Unemployment can only be eliminated by stimulating consumption (e.g., by increasing the propensity to consume through redistribution) or investment (e.g., through credit development policies). By extension, we could imagine that public spending could play a part in stimulating aggregate demand.

The contrast with the model without credit rationing is therefore significant since, in the latter, a simple reduction in nominal wages is sufficient to resolve labor market imbalance (Piluso et al., 2023).

13 Remember that Keynes rejected the "*second classical postulate*" but accepted the first, according to which the marginal productivity of the volume of employment must be equal to the real wage. Thus, since factor returns are decreasing, any rise in the level of production, and hence any fall in involuntary unemployment, is accompanied by a fall in the marginal productivity of labor and hence in the real wage.
14 When credit market equilibrium is restored, the negative impact of the interest rate on the level of employment is recovered, in line with Cartelier's (2018) model.

5 Conclusion

Linking unemployment to the credit market is not self-evident: it is necessary to adopt the hypothesis of asymmetry between financial and industrial capital, justified by the effective functioning of the credit market when it is rationed.

This result leads to the emergence of a further hypothesis, concerning the wage-employment relationship. The Keynesian theory of involuntary unemployment has been at a standstill since the contributions made by Cartelier (1995) and Glustoff (1968). Glustoff's model demonstrated Keynes's conjecture remarkably well, albeit with the caveat that the nominal wage cannot, by hypothesis, reach the value corresponding to the equilibrium level of the real wage. It is certainly possible to amend such a model by adopting the hypothesis of a decreasing link between wages and the demand price of capital, as well as a temporary equilibrium framework (Julien, 2004). Nevertheless, there is still a limit to Keynes's result: While a fall in wages may cause effective demand to fall, entrepreneurs may also anticipate the opposite and increase the level of employment. Reading between the lines of chapter 19 of Keynes's *General Theory* (1936), it appears that, in short, anything is possible with regard to the direction of the relationship between wages and employment. The same type of problem confronts L. Julien's model, in which the result depends on an *ad hoc* anticipation function.

The hypothesis of asymmetry between finance and business, which characterizes the financial market economy, helps to move the debate forward. The addition of such a hypothesis to a Glustoff–Cartelier-type scheme yields a nominal wage whose variations have no effect on unemployment.

Acknowledgements: Thanks to Jean Cartelier (specialist in general equilibrium models and unemployment theories) for their reading, commenting, and criticizing of the article.

Funding information: The author indicates personal funding.

Author contributions: The author confirms the sole responsibility for the conception of the study, presented results and manuscript preparation.

Conflict of interest: The author states no conflict of interest.

Data availability statement: Data sharing is not applicable (theoretical model).

Article note: As part of the open assessment, reviews and the original submission are available as supplementary files on our website.

References

Azar, J., Huet-Vaughn, E., Marinescu, I., Taska, B., & Wachter, T. (2024). Minimum wage employment effects and labour market concentration. *The Review of Economic Studies*, *91*(4), 1843–1883. doi: 10.1093/restud/rdad091.

Bernanke, B., & Getler, M. (1989). Agency costs, net worth and business fluctuations. *American Economic Review*, *79*(1), 14–31.

Berr, E. (2018). *L'économie post-keynésienne, Histoire, Théories, Politiques*. Seuil.

Blinder, A. (1987). Credit rationing and effective supply failures. *Economic Journal*, *97*, 327–352.

Block, S., & Galabuzi, G. E. (2022, April). *Assessing the labour market impacts of Ontario's 2018 minimum wage increase*. Canadian Centre for Policy Alternatives. https://policyalternatives.ca/sites/default/files/uploads/publications/Ontario%20Office/2022/04/One%20step%20forward.pdf.

Cahuc, P., & Zylberberg, A. (2004). *Microéconomie du marché du travail*, Repères.

Card, D., & Krueger A. B. (1994). Minimum wages and employment: A case study of the fast-food industry in New Jersey and Pennsylvania. *The American Economic Review*, *84*(4), 772–793.

Cartelier, J. (1995). *L'économie de Keynes, Brussels, De Boek Université, Ouvertures économiques collection*. Ballise Series.

Cartelier, J. (1996). Chômage involontaire d'équilibre: Asymétrie entre salariés et non-salariés, la loi de Walras restreinte. *Revue Economique*, *47*(3), 655–666.

Cartelier, J. (2018). *Money, markets and capital: The case for a monetary analysis*. Routledge.

Cengiz, D., Dube, A., Lindner, A., & Zipperer, B. (2019). The effect of minimum wages on low-wage jobs: Evidence from the United States using a bunching estimator. *Quarterly Journal of Economics*, *134*(3), 1405–1454.

Cherif, M. (1999). Asymétrie d'information et financement des PME innovantes par le capital-risque. *Revue d'Economie Financière*, *4*(54), 163–178.

Clemens, J., & Wither, M. (2019). The minimum wage and the Great Recession: Evidence of effects on the employment and income trajectories of low-skilled workers. *Journal of Public Economics*, *170*, 53–67.

Gathak, M., Morelli, M., & Sjöström, T. (2002), Credit rationing, wealth inequality and allocation of talent. *Discussion Paper*, TE/02/441, The Suntory Centre.

Glustoff, E. (1968). On the existence of a Keynesian Equilibrium. *Review of Economic Studies*, *3*(35), 327–334.

Julien, L. (2004). Chômage involontaire d'équilibre et flexibilité des prix dans une économie monétaire. *Revue d'Economie Appliquée*, *57*(3), 113–140.

Julien, L. A., & Sanz, N. (2005). Monopolistic competition, transaction costs and multiple equilibria. *Economics Letters*, *87*(1), 21–26.

Kara, E. (2024). Unemployment volatility in a generalized staggered Nash wage bargaining framework. *Canadian Journal of Economics*, *57*(2), 378–400.

Kashyap, A., Stein, J., & Wilcox, D. (1994). Credit conditions and the cyclical behaviour of inventories. *Quarterly Journal Of Economics*, *109*, 565–592.

Keynes, J. M. (1930). *A treatise on money*. Classiques Garnier Edition, 2019.

Keynes, J. M. (1936). *The general theory of employment, interest and money*. French translation, Payot.

Kojima, N. (2009). Imperfect competition in differentiated credit contract markets. *Annals of Finance*, *5*(2), 175–187.

Lavoie, M., Monvoisin, V., & Ponsot, J. F. (2021). *L'économie postkeynésienne*. La Découverte.

Layard, R., Nickell, S., & Jackman, R. (1991). *Unemployment: Macroeconomic performance and the labour market*. Oxford.

Le Heron, E., & Cottin-Euziol, E. (2021). Dynamique d'un modèle post-keynésien stock flux cohérent avec financement des dépenses courantes de production. *Economie Appliquée*, *1*(2), 83–114.

Le Héron, E., & Mouaki, T. (2008). A post-keynesian stock-flow consistent model for dynamic analysis of monetary policy shock on banking behavior. *Metroeconomica*, *59*(3), 405–440.

Ludovic, J. (2004). Chômage involontaire d'équilibre et flexibilité des salaires dans une économie monétaire. *Economie Appliquée*, *57*(3), 113–140.

Malinvaud, E. (1980). *Réexamen de la théorie du chômage*. Calmann Lévy.

Piluso N. (2019). *Les theories économiques de la monnaie*. Ellipses.

Piluso, N., & Colletis, G. (2021). A Keynesian reformulation of the WS-Ps model: Keynesian unemployment and Classical unemployment. *Economia Politica*, *38*, 447–460.

Piluso, N., & Cottin-Euziol, E. (2024). Keynes et les fondements ricardiens du marxisme. *Cahiers d'Economie Politique*, *1*(84), 147–174.

Piluso, N., Le Heron, E., & Cottin-Euziol, E. (2023). *Is Keynes's involuntary unemployment only cyclical? A review of the debates on the formalization of Keynesian unemployment. Economic Interventions, Papers in Political Economy, online article*. https://journals.openedition.org/interventionseconomiques/19694.

Ray, D. (2024). Contracts, wage differentials and involuntary unemployment. *Studies in Microeconomics*, *12*(1), 10–31. doi: 10.1177/232102222412455.

Say, J. B. (1999). *Cours d'économie politique*. Flammarion.

Stiglitz, J., & Weiss, L. (1981). Credit rationing in markets with imperfect information. *American Economic Review*, *71*, 393–410.

Taylor, J. B. (1993). Discretion vs policy rules in practise. *Carnegie-Rochester Series on Public Policy*, *39*, 193–214.

Toussaint Armel, B. (2015). *La monnaie endogène, une critique de la théorie quantitative de la monnaie*. L'Harmattan.

Woodford, M. (2002). *Interest and prices*. Princeton University Press.

Zhou, S. (2023). Relationship between minimum wage and the unemployment rate. *Highlights in Business, Economics and Management*, *21*, 555–558. doi: 10.54097/hbem.v21i.14672.

Appendix

The optimal labor demand is then:

$$L^{d*} = \left[\frac{\alpha A \left(\frac{b}{a+b+1} \right)^{\beta} (1+i)^{\beta}}{\left\{ \left[\frac{A[D]^{\frac{2\beta(1-\alpha-\beta)+\alpha+\beta}{1-\alpha-\beta}}}{(C)^{\frac{1}{1-\alpha-\beta}}} \right] [E] \right\}^{\frac{\beta(1-\alpha-\beta)+\alpha+\beta}{1-\alpha-\beta}(1-\beta)}} \right]^{\frac{1}{1-\alpha-\beta}}.$$

And involuntary unemployment U is given by the following expression (with L^s the labor supply)

$$U = L^s - L^d = L^s - \left[\frac{\alpha A \left(\frac{b}{a+b+1} \right)^{\beta} (1+i)^{\beta}}{\left\{ \left[\frac{A[D]^{\frac{2\beta(1-\alpha-\beta)+\alpha+\beta}{1-\alpha-\beta}}}{(C)^{\frac{1}{1-\alpha-\beta}}} \right] [E] \right\}^{\frac{\beta(1-\alpha-\beta)+\alpha+\beta}{1-\alpha-\beta}(1-\beta)}} \right].$$