



The macroeconomic impact of organised crime: A post-Keynesian analysis



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ARTICLE INFO

Keywords:

Post-Keynesian
Effective demand
Organised crime
Criminal sector
Degree of capacity utilization
Growth rate

ABSTRACT

The paper proposes an extended post-Keynesian model, where effective demand drives income levels and growth rates, to explain how organised crime affects the economy. In our set-up, some criminal activities, such as extortion, the criminal trade and corruption, reduce demand by draining resources from the legal sector; whereas others, such as money laundering, increase demand. The model determines under which conditions each effect prevails. Finally, we perform a simulation exercise that considers Italy, showing that the size of the criminal trade is so excessively large that organised crime impacts negatively on the Italian economy. In this context, we also provide several policy recommendations.

1. Introduction

Organised crime (OC) has a significant economic size: for 2006, Schneider (2010) provides a preliminary estimate of USD 790.0 billion for worldwide revenues attributed to criminal activity. In the context of supply side analysis, the empirical results seem to support the view that both crime and OC have an adverse impact on the level of economic activity and the growth process (Powell et al., 2010; Daniele, 2009).¹ According to Goulas and Zervoyianni (2015) and Daniele (2009), crime and OC can produce these negative effects through three main channels. The first channel is related to the lower capital productivity, due to decreased domestic savings and foreign investments; indeed, less secure property rights lead to a poor business climate, discouraging innovation and entrepreneurship. The second addresses a reallocation of public resources from growth-enhancing policies, related to education and infrastructure, to policies ensuring protection against crime. The third channel is connected to a lower labour supply in legal activities, given that individuals can choose to provide their services in illegal markets.

Despite its important contribution to understanding how OC distorts the allocation of factors, supply side analysis neglects the role of effective demand. Nevertheless, considering such a role carries a significant advantage, given that it is possible to disentangle the influence of OC on economic activity. The aim of the paper is to

provide a theoretical framework that shows the mechanisms through which OC alters the economy within a post-Keynesian approach. According to Lavoie (2014), an essential presupposition of the post-Keynesian economics is the principle of effective demand, which states that the economy is demand-led both in the short run and in the long run; as a corollary, this implies that investment determines saving. It is worth noting that the choice of a post-Keynesian model is based on the fact that we aim to focus on the impact of OC on the demand side of an economy, rather than on the supply. Thus, we propose a theoretical model to explain the channels through which OC can affect the level of effective demand and, in turn, the level of economic activity and the growth process of an economy. The model contributes to the existing post-Keynesian literature by simultaneously studying the economic effects of extortion, the trade in criminal goods,² corruption and money laundering, in other words, the typical crimes that characterise the workings of criminal organisations, as identified by the literature (Fiorentini and Peltzman, 1995).

Concerning theoretical analysis, the post-Keynesian literature shows that OC can alter the equilibrium level of income, affecting effective demand and the Keynesian multiplier (Pressman, 2008). Reuter (1984) assumes an exogenous demand for illegal goods that reduces the demand for legal goods: as a result, it negatively affects the equilibrium level of income. Based on the contribution of Reuter (1984), a model by Centorrino and Signorino (Daniele, 2009) assumes

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¹ These findings appear to be sufficiently robust, even allowing for the following problems about the quality of data available: under-reporting, namely the tendency of victims not to report crimes to the competent authorities, and the non-uniform legal definitions of offences in different countries (Powell et al., 2010).

² The Organisation for Economic Cooperation and Development (OECD, 2002) suggests the following definitions of an illegal economy and an underground economy. The former comprises productive activities that generate goods and services completely prohibited by law or those performed by unauthorised producers; the latter concerns productive activities that, per se, are legal but are deliberately performed in violation of the legal framework to evade the charges related to the payment of taxes or that are necessary to comply with the provisions of the law. In our model, the expression 'criminal good' identifies a good traded by criminal organisations, which can fall into one of the two categories of the OECD definition.

the demand for illegal goods as a linear function of legal income to focus on three elements: first, the propensity to consume illegal goods out of legal disposable income; second, the capacity of OC to appropriate legal income through crimes such as extortion; and, third, its propensity to consume illegal goods out of illegal income. Despite the vague specification of the demand for illegal goods, the analysis shows that OC causes, in addition to a fall in the equilibrium level of income, a reduction in the Keynesian income multiplier. Moreover, this literature suggests that the lower the share of criminal revenues recycled in the legal sector is, the greater the negative influence of OC on the equilibrium level of income. Indeed, in the OC literature, Unger (2007) argues that money laundering can produce both a positive and a negative impact on the level of economic activity: the former concerns inflows of illegal funds into the legal sector, whereas the latter concerns all crimes generating illegal funds. Although the empirical evidence appears to detect an overall adverse effect, a theoretical framework for explaining all forms of influence that OC exerts on an economy through its typical crimes is still lacking.

The main contribution of this paper is to fill the gap within a post-Keynesian model. In this context, we implement the principle of effective demand through a standard neo-Kaleckian investment function, where investment decisions of firms depend on the level of economic activity.³ Our theoretical framework gathers the effect of the four crimes attributed to OC: extortion, corruption of public officials, the trade in criminal goods and money laundering. The model explains how the workings of OC have, *ex-ante*, an undetermined effect on the level of economic activity and the growth process. Indeed, whereas it decreases demand by draining resources through extortion, corruption of public officials and the promotion of the consumption of criminal goods, it increases demand through money laundering when the recycled income is allocated to the consumption of legal goods and real investments in legal activities. The model identifies the analytical conditions for a negative or positive impact on the level of economic activity and the growth process. Finally, to provide an *ex-post* evaluation of these conditions, we consider Italy as a case study to which a simulation exercise is applied, concluding that the impact of criminal organisations on Italian economic performance is negative and mainly depends on the key role played by the trade in criminal goods and money laundering.

The remainder of this paper is organised as follows. Section 2 is devoted to explaining the concept of OC and the four types of crimes referred to in the model. Section 3 describes the analytical model and the relationship between legal income and criminal income, in addition to examining how the presence of OC affects the level of economic activity and the growth process. Section 4 presents a simulation exercise applied to Italy. Finally, Section 5 summarises the key findings and provides some policy recommendations.

2. The characteristics of organised crime

Many countries are plagued by criminal organisations, such as the Yakuza in Japan (Hill, 2003), ‘La Cosa Nostra’ in Sicily (Gambetta, 1993), the Russian Mafia since the collapse of the Soviet Union (Varese, 2001), and the drug cartels in Colombia (Levitt and Rubio, 2005). Although criminal organisations differ from each other with respect to their origins and social and economic characteristics, they

³ Within the post-Keynesian economics, we can distinguish five strands, which share the principle of effective demand but focus their analysis on specific themes: the fundamentalist Keynesians, the Kaldorians, the Kaleckians, the Sraffians and the Institutionalists (Lavoie, 2014). By assuming a neo-Kaleckian investment function, we can describe in a simple analytical way the role played by effective demand. However, we prefer to refer to our model as post-Keynesian instead of neo-Kaleckian: in fact, it does not consider others crucial elements of the neo-Kaleckian approach, such as, for instance, the assumption that prices are of the cost-plus type and depend on conventional forces instead of market forces (Lavoie, 2014).

share some common traits. Hence, based on the literature (Paoli, 2002), we define OC as a set of criminal organisations with the following specific traits:

- ✓ They tend to act in geographical areas characterised by an institutional vacuum with the aim of filling the gaps left by the legitimate authority in regulating relationships among individuals.
- ✓ They are involved in various activities, both economic and non-economic, both legal and illegal.
- ✓ They develop various structures to coordinate their affiliates.
- ✓ They use violence or the threat of violence to achieve their objectives.

The first two traits identify the activities performed by OC. The first defines the local dimension of OC: only where there is an institutional vacuum, OC finds fertile ground to develop, given that there is room for it to regulate individual relationships, including those related to property rights. When it is difficult to ensure the protection of property rights and contract enforcement, criminal organisations can provide protection services, acting as guarantor and mediator in highly uncertain transactions.⁴ An institutional vacuum can be due to the state’s being geographically, ethnically or socially distant from its population; to the occurrence of recent wars, uprisings and other political changes; or to the presence of widespread illegal activities (Kumar and Skaperdas, 2009). In this context, the same legal institutions sometimes use criminal organisations to retain indirect control over some regions.⁵ The second trait defines the global and economic dimension of OC; according to Schelling (1971), territorial control is required for a criminal organisation to run its business. Criminal organisations perform many economic activities, some of which are illegal, such as the production and distribution of drugs and human trafficking. Overall, these activities sketch a picture of the international projection of OC (Fiorentini, 2000). The link between legal and illegal economic activities is represented by money laundering, through which OC employs the proceeds of crime in the legal economy, infiltrating mainly traditional manufacturing sectors dominated by small or medium-sized enterprises, low levels of technology and human capital, limited market competition and the strong presence of the public sector (Lavezzi, 2008).

The third and the fourth traits define the structure of and instruments used by OC to achieve its objectives, respectively. In terms of the structure concerned, OC employs hierarchical forms of coordination among its members, particularly when it performs activities aimed at regulating the relationships between individuals and establishing territorial control, whereas more flexible forms of organisation prevail for those activities considered more strictly profit-driven (Paoli, 2002; Morselli, 2014).⁶ Among the tools used by OC to impose its authority, violence or the threat of violence is peculiar to such organisations. Schelling (1971) shows that violence is frequently associated with the adoption of hierarchical forms of coordination and the establishment of monopolistic or oligopolistic markets. Note that the first and the fourth traits underline the ‘anti-state’ nature of the OC: the state should be the only legitimate subject to regulate individual relationships, making use of violence, but criminal organisations aim to take its place in regions where they have strong local roots.

⁴ Varese (2001) explains the development of the Russian Mafia as a result of the climate of uncertainty and political weakness following the collapse of the Soviet Union, when many businessmen demanded criminal groups to provide protection. See also Dixit (2003).

⁵ As reported by Hill (2003), in the early twentieth century in Japan, political leaders and businessmen demanded that criminal groups, belonging to the Yakuza, fight the threat of political radicalism.

⁶ The United Nations Office on Drugs and Crime (UNODC, 2002) classifies 40 selected criminal organisations according to the forms of coordination: a rigid hierarchical structure prevails in Chinese and Eastern European organisations, whereas a network structure is detected for Mexican and Colombian cocaine cartels.

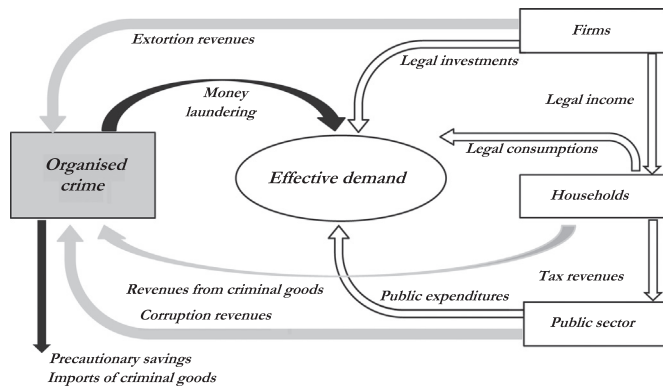


Fig. 1. The workings of OC and effective demand.
Source: Authors' elaboration.

In the literature, extortion, the trade in criminal goods, corruption and money laundering have been recognised as the main offences through which OC can affect economic performance. Extortion is a ‘tax’, typically to be paid in cash, imposed by OC upon firms based in a given region (Konrad and Skaperdas, 1998; Fiorentini and Peltzman, 1995). With this crime, OC pursues various objectives: first, it generates a steady income flow; second, it allows a social and economic network that facilitates the infiltration of OC into the legal economy to be created; and, third, it helps achieve a monopoly position in some productive sectors by forcing out of the market firms that are not integrated in the criminal network. The trade in criminal goods entails breaking the laws that prohibit or regulate their production and distribution. Revenues from these illegal economic activities, particularly those connected to the drug trade, represent the main income source for OC and an income outflow from the legal economic system (Reuter, 1984). Corruption allows OC to appropriate a share of public resources aimed at income transfers, services and infrastructures. This objective is achieved by altering the allocation mechanisms defined by markets or institutions and by increasing the standard costs for services and infrastructures (Barone and Narciso, 2013; Fiorentini and Peltzman, 1995). Finally, money laundering allows OC to conceal the illegal origin of criminal income and to transform it into effective purchasing power, namely into potential demand for consumption and investment (Masciandaro, 1999, 2007).

3. The theoretical model

The economy that we aim to model is based on a legal and a criminal sector interacting through the income flows generated by the four main OC offences: extortion, the trade in criminal goods, corruption and money laundering (Fig. 1).⁷

In the legal sector, three actors are involved: firms, households and the public sector. Firms produce legal income that is distributed to households, which, in turn, contribute to the government budget

⁷ It worth stressing that this paper focuses on the criminal economy rather than on the shadow economy, namely the non-observed economy. According to the OECD (2002), the non-observed economy consists of the following groups of productive activities: underground activities, illegal activities, informal activities, household activities for own final use and missing activities due to deficiencies in data collection. Note that the illegal sector includes productive activities that generate goods and services that are completely prohibited by law or those performed by unauthorised producers; by contrast, the underground sector includes productive activities that, per se, are legal but are deliberately performed in violation of the legal framework to evade the charges related to the payment of taxes or that are necessary to comply with the provisions of the law. In our model, the criminal sector that we refer to performs both productive activities, through the trade in criminal goods, and predatory activities, through extortion and corruption. Thus, our definition of the criminal sector includes, on the one hand, only part of the underground and illegal sectors as defined by the OECD (the productive activities directly performed by OC) and, on the other hand, a set of activities that do not fall within the definition of the non-observed economy.

balance by paying taxes. In this sector, only one type of legal good, which can be used as a consumption good, investment good or public good, is produced. In equilibrium, legal income (Y) must be equal to effective demand (Y_d), namely the total amount of legal consumption goods demanded by households, investment goods demanded by firms and public goods provided by the government. The criminal sector produces criminal income (\tilde{Y}) through offences such as extortion, the trade in criminal goods and corruption: extortion works similarly to a tax imposed by OC on firms; criminal goods are sold to households, such that they can also choose to spend their disposable income outside the legal sector; the corruption of public officials allows OC to appropriate a share of public resources. In all such cases, legal income flows from the legal sector towards the criminal sector. Finally, money laundering allows OC to transform a share of criminal income into effective purchasing power to be used within the legal sector, such that income flows from the criminal sector into the legal sector under the form of consumption and investment.

The production and allocation of criminal income influence effective demand: on the one hand, extortion, the trade in criminal goods and corruption reduce effective demand by determining income outflows from the legal sector; on the other hand, money laundering increases effective demand by determining income inflows towards the legal sector. The model that we propose describes the opposing action of these forces and explains how they affect the level of economic activity and the growth process.

The rest of Section 3 is structured as follows. Sections 3.1 and 3.2 describe the aggregate demand and the production and allocation of criminal income, respectively. In Sections 3.3, 3.4 and 3.5, eight propositions regarding the ratio between criminal and legal income, the degree of capacity utilisation and the capital stock growth rate are then formulated; the relationship between these three variables and the parameters included in the model is also described. Finally, Section 3.6 summarises the theoretical results.

3.1. The legal sector

Eq. (1) describes effective demand, which is equal to the total amount of legal consumption goods demanded by households (C_l), investment goods demanded by firms (I_l) and public goods provided by the government (G).⁸

$$Y_d = C_l + G + I_l \tag{1}$$

$$C_l = C_l^l + C_l^o = (1 - c_d)c(1 - \alpha_c - \tau)Y + \beta_l\beta\tilde{Y} \tag{2}$$

$$G = \tau(1 - \alpha_c)Y \tag{3}$$

$$I_l = I_l^l + I_l^o = I_l^l + \beta_k(1 - \beta_l)\beta\tilde{Y} \tag{4}$$

Eq. (2) defines the legal consumption of households (C_l) as the sum of the consumption of legal goods purchased with both legal income (C_l^l) and criminal income (C_l^o); in practice, households' disposable income can derive from the legal sector, if a legal activity is performed, and the criminal sector, when a role is performed in criminal organisations. The consumption of legal goods purchased with legal income (C_l^l) is a linear function of legal income, net of extortion and tax payments: $\alpha_c \in [0,1]$ is the extortion rate, $\tau \in [0,1]$ is the tax rate, $c_d \in [0,1]$ is the share of the consumption of criminal goods in total consumption and $c \in [0,1]$ is the propensity to consume both legal and criminal goods out of legal income. The consumption of legal goods purchased with criminal income (C_l^o) is a linear function of laundered criminal income ($\beta\tilde{Y}$): $\beta \in [0,1]$ is the laundered share of criminal income and $\beta_l \in [0,1]$ is the propensity to consume legal goods out of laundered criminal income. Hence, the consumption of legal goods by households

⁸ In Eqs. (2–3) the superscripts refer to the income spent (l for legal and o for criminal), and the subscript refers to the type of good (l for legal).

using criminal income identifies the first channel through which laundered criminal income flows from the criminal sector into the legal sector. In Eq. (2), we assume different propensities to consume legal goods depending on whether legal income or criminal income is used, $((1 - c_d)c \neq \beta_l\beta)$: this assumption highlights the role of money laundering, which affects only the propensity to consume out of criminal income.⁹

Eq. (3) defines public goods provided by the government (G) as a linear function of tax revenues (τY), with $\alpha_c \in [0,1]$ being the tax share diverted by criminal organisations through the corruption of public officials. A balanced budget is assumed for the government, but only a share of tax revenues can be used to provide public goods: indeed, one unit of tax revenue allows the government to provide only $1 - \alpha_c$ units of public goods.¹⁰

Eq. (4) defines investments in legal activities (I_l) as the sum of investments related to criminal income (I_l^o) and to legal income (I_l^l). Investments funded by criminal income (I_l^o) are a linear function of laundered criminal income ($\beta\tilde{Y}$), net of consumption of legal goods made by criminal organisations, where $\beta_k \in [0,1]$ is the propensity to invest in real activities. Hence, these investments identify the second channel through which laundered criminal income flows from the criminal sector into the legal sector. Regarding investment decisions of firms related to the level of legal income (I_l^l), it is assumed that the standard neo-Kaleckian investment function holds: the ratio between the demand for investment goods and the capital stock ($g_l^l = I_l^l/K$) is a positive function of the level of economic activity in the legal sector. Eq. (5) defines the investment function:

$$g_l^l = \frac{I_l^l}{K} = \gamma + \gamma_u u \tag{5}$$

The investment decisions of firms are a linear function of the degree of capacity utilisation ($u = Y/Y_p$), i.e., the level of economic activity: the proportion of potential output that is realised; γ_u and γ are the sensitivity of investments to the degree of capacity utilisation and to other factors not related to the level of economic activity, respectively.

Finally, regarding the production side, we assume a fixed coefficient production function, where the legal actual output (Y) is always lower than the legal potential output (Y_p). Eq. (6) defines the production function as follows:

$$Y = \frac{Y}{L} = a_l L \leq a_k K = \frac{Y_p}{K} K = Y_p \tag{6}$$

In this expression, a_l is the reciprocal of labour input for one unit of effective output (Y/L), and a_k the reciprocal of capital input for one unit of potential output (Y_p/L).

3.2. The criminal sector

Eq. (7) describes how the criminal sector produces criminal income (\tilde{Y}), which is equal to the total amount of crime revenues deriving from extortion (R_e), the trade in criminal goods (R_d) and corruption (R_c). Eqs. (8–10) describe the production of criminal income as follows:¹¹

$$\tilde{Y} = R_e + R_d + R_c \tag{7}$$

$$R_e = \alpha_e Y \tag{8}$$

$$R_d = \alpha_d C_d = \alpha_d (C_d^l + C_d^o) = \alpha_d [c_d c (1 - \alpha_c - \tau) Y + \beta_d (1 - \beta) \tilde{Y}] \tag{9}$$

$$R_c = \alpha_c \tau Y \tag{10}$$

According to Eq. (8), extortion revenues (R_e) are a linear function of legal income because the extortion rate is typically set by OC as a share of it. Eq. (9) shows that criminal trade revenues (R_d) come from the sale of criminal goods to households (C_d), with $\alpha_d \in [0,1]$ being the share of criminal trade turnover not used to import criminal goods from abroad: indeed, it is assumed that OC does not directly produce criminal goods but only sells them after being imported. Specifically, the consumption of criminal goods purchased by households using legal income (C_d^l) is a linear function of legal income, net of extortion and tax payments; whereas the consumption of criminal goods purchased by households using non-laundered income (C_d^o) is a linear function of criminal income, with $\beta_d \in [0,1]$ being the propensity to consume criminal goods out of non-laundered income $((1 - \beta)\tilde{Y})$. Finally, Eq. (10) defines corruption revenues (R_c) as the share of tax revenues (τY) diverted by criminal organisations through the corruption of public officials.

Eqs. (11–12) describe the criminal income allocation.¹² The first decision that OC must make regards the share of criminal income to launder ($\beta\tilde{Y}$) and the share not to launder $((1 - \beta)\tilde{Y})$. Second, the share of laundered criminal income can be allocated to the consumption of legal goods (C_l^o), to investments in legal activities inside the region (I_l^o) and to the accumulation of precautionary savings (S_l^o), in other words, to investments in legal financial activities outside the region ($S_l^o = (1 - \beta_k)(1 - \beta_l)\beta\tilde{Y}$). Third, criminal organisations can allocate non-laundered income $((1 - \beta)\tilde{Y})$ to the consumption of criminal goods or to precautionary savings in liquid form inside the region ($C_d^o + S_o^o$).

$$\tilde{Y} = (C_l^o + C_d^o) + I_l^o + (S_l^o + S_o^o) \tag{11}$$

$$\tilde{Y} = \beta_l \beta \tilde{Y} + \beta_d (1 - \beta) \tilde{Y} + \beta_k (1 - \beta_l) \beta \tilde{Y} + (1 - \beta_k)(1 - \beta_l) \beta \tilde{Y} + (1 - \beta_d)(1 - \beta) \tilde{Y} \tag{12}$$

Eqs. (11–12) highlight two key issues of the model concerning laundered criminal income ($\beta\tilde{Y}$) and precautionary savings ($S_l^o + S_o^o$). From the effective demand perspective, money laundering allows OC to allocate criminal income to the consumption of legal goods or investment in real activities inside the region: these are the channels through which laundered criminal income flows from the criminal sector into the legal sector, supporting effective demand; the laundered share of criminal income (β), the propensity to consume legal goods out of laundered criminal income (β_l) and the propensity to invest in real activities out of laundered criminal income (β_k) denote the intensity of this effect.¹³ Precautionary savings represent the criminal income share hoarded either in legal activities outside the region or in liquid form inside the region: this income share cannot in any manner flow into the legal sector, and it represents a net loss. The amount of precautionary savings is assumed to be positive. Saving for precautionary reasons is indeed justified because the working life of criminals is typically very short, given that they are liable to be arrested by the police or killed by

⁹ Note that in Kaldor (1966), different propensities to consume out of wages and profits are assumed to consider the differing sources of such incomes.

¹⁰ Our model does not specifically consider how the activity of the government affects the criminal sector. We assume a 'restricted' role for the government, in the sense that public expenditures are not differentiated into different budget expenditure items (including, e.g., the policy against crime). Nevertheless, this assumption does not significantly influence our theoretical and empirical results: first, the model focuses on the level of effective demand, such that it is only the level of public expenditures that is relevant and not the manner in which the government allocates them to different budget expenditure items; second, in the simulation exercise, the estimated parameters implicitly reflect the effects of the public policy against crime along the reference period. Accordingly, the interest deriving from a more in-depth study of the government role notwithstanding, a specific framework of analysis is required, which exceeds the scope of this paper.

¹¹ In Eq. (9), as in Eqs. (2–3), the superscripts refer to the income spent (l for legal

(footnote continued)

and o for criminal), whereas the subscripts define the type of consumption good (d for criminal).

¹² In Eq. (11), the superscripts refer to the income used (o for criminal income, which can be laundered or non-laundered), whereas the subscripts define the nature of the consumption/investment/saving (l for legal consumption, investment or saving; d for consumption of criminal goods; o for liquid precautionary saving hoarded in the region).

¹³ Note that money laundering costs can be related to the consumption of criminal goods, when such goods are used to hide the illegal origin of criminal income. In this case, parameter β_d also considers this effect.

other criminals. Thus, they save a lot of assets to protect their families against such risks. Moreover, the attempt to launder criminal income within the legal sector can be discovered by the police, exposing criminal organisations to the risk of seizure of their real and financial assets (Masciandaro, 1999).¹⁴

3.3. The relationship between criminal and legal income

OC produces criminal income through extortion, the trade in criminal goods and corruption: these crimes lead to an income outflow from the legal sector towards the criminal sector. The relationship between criminal income (\tilde{Y}) and legal income (Y) is described by Proposition (1), which is derived from the algebraic manipulation of expressions (7–10).

Proposition 1.: *The relative size of the criminal sector with respect to the legal sector (ϵ) only depends on the parameter values and does not change when the size of the legal sector changes.*

$$\epsilon = \frac{\tilde{Y}}{Y} = \frac{\alpha_e + \alpha_d c_d c (1 - \alpha_e - \tau) + \alpha_c \tau}{1 - \alpha_d \beta_d (1 - \beta)} \quad (13)$$

Proof of Proposition (1) in Appendix A.

Eq. (13) shows that the criminal income is a linear function of the legal income, with the intercept being equal to zero ($\tilde{Y} = \epsilon Y$): all criminal revenues come from the legal sector, and OC can produce ϵ units of criminal income for each unit of legal income. The relative size of the criminal sector with respect to the legal sector (ϵ) only depends on the parameters and can vary between 0 and $+\infty$: ϵ is equal to zero if the income outflows from the legal sector are equal to zero ($(\alpha_e + \alpha_d c_d c (1 - \alpha_e - \tau) + \alpha_c \tau) Y = 0$), namely if legal income is equal to zero ($Y = 0$) or OC does not perform any criminal activity ($\alpha_e, c_d, \alpha_c = 0$); otherwise, ϵ is greater than zero and can tend towards $+\infty$ because criminal income typically exceeds the income outflows from the legal sector ($(\alpha_e + \alpha_d c_d c (1 - \alpha_e - \tau) + \alpha_c \tau) Y \leq \tilde{Y}$). This occurs since the criminal income multiplier ($1/[1 - \alpha_d \beta_d (1 - \beta)] \geq 1$), which measures the change in criminal income against the change of one unit in the legal income outflow, is greater than one if the following conditions hold: a) a share of the income outflows is allocated to the consumption of criminal goods ($\beta_d (1 - \beta) > 0$); and b) a share of criminal trade turnover is not used to import criminal goods from abroad ($\alpha_d > 0$). The economic intuition of the criminal income multiplier is as follows: first, when OC produces one unit of income outflow from the legal sector, this unit must be distributed to households performing criminal activities; second, this increase in household disposable income can be allocated to the consumption of criminal goods without the need to be recycled ($\beta_d (1 - \beta) > 0$), resulting in an increase in criminal trade revenues; and, third, if OC does not use all these revenues to purchase criminal goods from abroad ($\alpha_d > 0$), then it can also distribute the fraction $\alpha_d \beta_d (1 - \beta)$ of the original unit of income outflow to households, producing a further increase in their criminal disposable income, etc. Overall, in the criminal sector, the criminal income multiplier works as the standard Keynesian multiplier does in the legal sector, and its size is positively related to the share of criminal trade turnover not used to import criminal goods (α_d) and the propensity to consume criminal goods out of non-laundered income (β_d), whereas it is negatively related to the laundered share of criminal income (β).¹⁵

The workings of OC, on one hand, involve a predatory activity related to offences such as extortion and corruption, which defines its local dimension; on the other hand, they entail a criminal economic

¹⁴ Regarding financial investments outside the region, it is assumed that revenues coming from such activities are not used in the region where the criminal organisation is located.

¹⁵ The concept of the criminal income multiplier was first introduced by Reuter (1984).

activity related to the trade in criminal goods, which amplifies its impact on the economy. Thus, the interaction between the legal sector and the criminal sector cannot be described as a zero-sum game since criminal income can exceed the income outflows from the legal sector.

By differentiating with respect to the parameters, we obtain the following result:

Proposition 2.: *The relative size of the criminal sector with respect to the legal sector (ϵ) is positively related to $\alpha_e, \alpha_c, \alpha_d, \beta_d, c$, and c_d , but it is negatively related to β ; the effect of τ is undetermined.*

Proof of Proposition (2) in Appendix A.

A rise in the extortion rate (α_e) determines two opposite effects: an increase in extortion revenues ($R_e = \alpha_e Y$) and a decrease in the criminal trade revenues related to the consumption of criminal goods that depends on legal income, i.e., on the disposable income of households, net of the extortion rate ($C_d^l = c_d c (1 - \alpha_e - \tau) Y$). The first effect is larger than the second, with the positive net impact on the relative size of the criminal sector (ϵ) amplified by the criminal income multiplier. A rise in the share of criminal trade turnover not used to import criminal goods (α_d) increases both criminal trade revenues ($R_d = \alpha_d (C_d^l + C_d^c)$) and the criminal income multiplier, such that it is positively related to the relative size of the criminal sector (ϵ). An increase in the propensity to consume criminal goods out of non-laundered income (β_d) raises the criminal income multiplier; an increase in the tax revenues diverted by OC through the corruption of public officials (α_c) raises corruption revenues ($R_c = \alpha_c \tau Y$), and an increase in the propensities to consume out of legal income (c, c_d) raises criminal trade revenues ($C_d^l = c_d c (1 - \alpha_e - \tau) Y$). Thus, these parameters (β_d, α_c, c and c_d) positively affect the relative size of the criminal sector (ϵ). The only parameter to be negatively related to the relative size of the criminal sector (ϵ) is the criminal income share laundered in the legal sector (β), because it negatively affects the criminal income multiplier. Finally, a rise in the tax rate (τ) causes two opposite effects: an increase in corruption revenues ($R_c = \alpha_c \tau Y$) against a decrease in the criminal trade revenues related to the consumption of criminal goods that depends on legal income, i.e., on the disposable income of households, net of the tax rate ($C_d^l = c_d c (1 - \alpha_e - \tau) Y$); the net impact on the relative size of the criminal sector (ϵ) depends on the parameter values, that is, on the relative strength of these effects.

3.4. The degree of capacity utilisation

In the legal sector, under the equilibrium condition, legal income and aggregate demand must be equal ($Y = Y_d$). Changes in the degree of capacity utilisation (u) allow the economy to satisfy this equilibrium condition. With the algebraic manipulation of expressions (1–6), we obtain the following result:

Proposition 3.: *The equilibrium value of the degree of capacity utilisation (\tilde{u}) depends on the behaviour of households, firms and the government. Nevertheless, it is also affected by the production and allocation of criminal income, in other words, by the workings of OC.*

$$\tilde{u} = \frac{\gamma}{\alpha_k \{1 - (1 - \alpha_e - \tau)(1 - c_d)c - [\beta_l + \beta_k(1 - \beta_l)]\beta\epsilon - (1 - \alpha_c)\tau\} - \gamma_u} \quad (14)$$

Proof of Proposition (3) in Appendix A.

Within post-Keynesian models, the level of economic activity is a positive function of the demand level, which, in turn, depends on the levels of consumption, investment and public expenditures. Eq. (14) shows that OC may positively or negatively affect the degree of capacity utilisation (u) by promoting an expansion or a contraction in the level of effective demand: on one hand, the crimes of extortion, trade in criminal goods and corruption tend to reduce effective demand; on the other hand, the allocation of laundered criminal income to the consumption of legal goods and investment in legal activities tends to raise effective demand. Overall, the net effect is uncertain, depending

on the value of the parameters.

The economic intuition can be better understood if the equilibrium value of the degree of capacity utilisation in an economy without OC (u^*) is compared to that of an economy with OC (\tilde{u}). By setting all parameters referring to OC equal to zero ($\alpha_e, \alpha_d, \alpha_c, \beta, \beta_d, \beta_l, \beta_k, c_d$), Eq. (15) allows us to obtain the equilibrium value of u^* .

$$u^* = \frac{\gamma}{a_k \{1 - (1 - \tau)c - \tau\} - \gamma_u} \tag{15}$$

With the algebraic manipulation of Eqs. (14–15), we obtain the following result:

Proposition 4.: *The equilibrium value of the degree of capacity utilisation in an economy without OC (u^*) is greater than the equilibrium value in an economy with OC (\tilde{u}) only if the reduction in the consumption of legal goods and public expenditures, connected to the crimes of extortion, trade in criminal goods and corruption, exceeds the rise in the consumption of legal goods and investment in legal activities fuelled by laundered criminal income.*

$$u^* > \tilde{u} \Rightarrow [\alpha_e + (1 - \alpha_e - \tau)c_d]c + \alpha_c \tau > [\beta_l + \beta_k(1 - \beta_l)]\beta \epsilon \tag{16}$$

Proof of Proposition (4) in Appendix A.

In expression (16), the term $[\alpha_e + (1 - \alpha_e - \tau)c_d]c$ denotes the lower share of the legal income allocated to the consumption of legal goods by households, and the term $\alpha_c \tau$ denotes the lower share of the legal income allocated by the government to public expenditures; otherwise, the term $[\beta_l + \beta_k(1 - \beta_l)]\beta \epsilon$ identifies the legal income share that criminal organisations turn into effective demand for legal goods and investments through money laundering. OC negatively affects the level of economic activity when inequality (16) holds: the decrease in effective demand resulting from extortion, the trade in criminal goods and corruption, namely the first and second terms, exceeds the increase in effective demand fuelled by the money laundering, the third term.

By differentiating Eq. (14) with respect to the parameters, we obtain the following result:

Proposition 5.: *The degree of capacity utilisation (\tilde{u}) is positively influenced by $\alpha_d, \beta_d, c, \beta_l$, and β_k , whereas the impact of $\alpha_e, \alpha_c, c_d, \tau$, and β is uncertain.*

Proof of Proposition (5) in Appendix A.

The share of criminal trade turnover not used to import criminal goods from abroad (α_d), the propensity to consume criminal goods out of non-laundered income (β_d) and the propensity to consume out of legal income (c) positively affect the degree of capacity utilisation (\tilde{u}). Parameter α_d raises both the criminal income multiplier and criminal trade revenues, whereas β_d only raises the criminal income multiplier: given the legal income outflows from the legal sector and the criminal income share to be laundered (β), an increase in α_d and β_d allows criminal organisations to produce a higher level of criminal income, which can be allocated to legal consumptions and investments. Parameter c raises the legal income share allocated to legal consumption. Additionally, the propensities to consume legal goods (β_l) and to invest in legal activities (β_k) out of laundered income positively influence the degree of capacity utilisation (\tilde{u}); indeed, they increase the share of laundered income that OC turns into effective demand. Increases in the extortion rate (α_e), the tax share diverted through the corruption of public officials (α_c) and the share of the consumption of criminal goods in total consumption (c_d) reduce the degree of capacity utilisation (\tilde{u}) only if the increase in the consumption of legal goods and investments in legal activities fuelled by criminal income is not sufficient to offset the decrease in the consumption of legal goods and the public expenditure fuelled by legal income. The impact of the size of the public sector is more complex: an increase in the tax rate (τ) would positively affect the degree of capacity utilisation (\tilde{u}) if the increase in public expenditures, net of corruption proceeds, and the increase in the consumption of legal goods and investment in legal activities fuelled by criminal income were higher than the decrease in

the consumption of legal goods fuelled by legal income. Finally, the effect of the laundered share of criminal income (β) on the degree of capacity utilisation (\tilde{u}) is uncertain: a rise in β , on the one hand, increases the criminal income share laundered in the legal sector; on the other hand, it lowers the criminal income multiplier, namely the level of criminal income. The first effect prevails if the elasticity of the relative size of the criminal sector (ϵ) with respect to β is less than 1.

In general, OC negatively affects the level of economic activity if the legal income outflows are greater than the criminal income share turned into effective demand. To be more precise, the workings of OC can be described as follows. First, criminal organisations produce legal income outflows through extortion, the trade in criminal goods and corruption, and they produce criminal income according to the economic process identified by the criminal income multiplier: given the criminal income share to be laundered (β), the greater the propensity to consume criminal goods out of non-laundered income ($\beta_l \rightarrow 1$), i.e., the lower the precautionary savings hoarded in liquid form, the greater the relative size of the criminal sector (ϵ) will be. Second, criminal organisations can turn a positive share of criminal income into effective demand: given the criminal income share to be laundered (β), the greater the propensities to consume legal goods and to invest in legal activities out of laundered income ($\beta_l, \beta_k \rightarrow 1$), i.e., the lower the precautionary savings hoarded in financial activities, the greater the degree of capacity utilisation (\tilde{u}) will be. Third, the criminal income share to be laundered (β) links the production of criminal income to its allocation: on the one hand, β negatively affects the relative size of the criminal sector (ϵ), by reducing the criminal income multiplier; on the other hand, β positively affects the degree of capacity utilisation (\tilde{u}), by raising effective demand. To clarify the relationship between the degree of capacity utilisation (\tilde{u}) and the relative size of the criminal sector (ϵ), it is worth analysing the following extreme cases. In the first, criminal income is exclusively turned into effective demand ($[\beta_l + \beta_k(1 - \beta_l)]\beta = 1$): the workings of OC entail that one unit of income drained from the legal sector produces the lowest increase in ϵ and the highest possible increase in \tilde{u} . In the second case, criminal income is exclusively allocated to the consumption of criminal goods ($\beta_d = 1; \beta = 0$): the workings of OC entail that one unit of income drained from the legal sector produces the highest increase in ϵ and the highest possible reduction in \tilde{u} ; OC behaves similarly to a leech, extracting blood from the legal sector and leaving it lifeless.

3.5. The capital stock growth rate

The capital stock growth rate is equal to the ratio between legal investments in real activities and the capital stock (I_r/K); therefore, it depends on the investment decisions of firms related to legal income and criminal income, as described by Eqs. (5 and 4). Eq. (17) defines the capital stock growth rate.

$$g = \frac{I_r^l + I_r^o}{K} = \gamma + \gamma_u u + \beta_k(1 - \beta_l)\beta \frac{\tilde{Y}_p}{K} \frac{Y_p}{Y} = \gamma + \gamma_u u + \beta_k(1 - \beta_l)\beta \epsilon u a_k \tag{17}$$

By substituting the equilibrium value of the degree of capacity utilisation (\tilde{u}) in expression (17), we obtain the following result:

Proposition 6.: *The equilibrium value of the capital stock growth rate (\tilde{g}) depends on the behaviour of households, firms and the government. Nevertheless, OC also affects, indirectly and directly, the growth rate through its impact on the degree of capacity utilisation and its investment decisions in legal activities.*

$$\tilde{g} = \gamma + \gamma_u \tilde{u} + \beta_k(1 - \beta_l)\beta \epsilon \tilde{u} a_k \tag{18}$$

Proof of Proposition 6 in Appendix A.

With respect to the analysis of the level of economic activity, the main difference shown by Eq. (18) is that OC affects the growth rate (\tilde{g}) through two channels: first, the indirect influence on the investment

Table 1
Parameter values (percentage points of GDP).
Source: Authors' elaboration.

Parameters	Values	Source
α_e	0.0045	Calderoni (2014), SOS Imprese-Confesercenti (2011)
α_d	0.9500	Our assumption
α_c	0.0010	Our assumption
β	0.6009	Ardizzi et al. (2012; 2014a; 2014b)
β_l	0.7621	Our assumption
β_d	0.1340	Our assumption
β_k	0.5042	Unger (2007)
τ	0.3193	Dataset AMECO
c	0.8157	Dataset AMECO
c_d	0.0657	Calderoni (2014), SOS Imprese-Confesercenti (2011)
γ	0.0240	Our assumption
γ_u	0.0246	Our assumption
a_k	0.4349	Dataset AMECO

decisions of firms via the impact on the degree of capacity utilisation ($\gamma_u \tilde{u}$); and, second, the investment decisions made directly by criminal organisations and financed by laundering a share of criminal income ($\beta_k(1 - \beta_l)\beta\epsilon\tilde{u}a_k$). As a result, two effects can be observed: first, the conditions to be satisfied to obtain a positive impact of criminal organisations on the growth rate (\tilde{g}) are less binding compared to those required for the degree of capacity utilisation (\tilde{u}); and, second, the sensitivity of the growth rate (\tilde{g}) with respect to changes in the degree of capacity utilisation (\tilde{u}) tends to be higher. Overall, the workings of OC can have a greater negative impact on the level of economic activity than on the growth process, and they can amplify economic fluctuations during the business cycle.

The economic intuition can be better understood if the equilibrium value of the growth rate in an economy without OC (g^*) is compared to that of an economy with OC (\tilde{g}). By setting all parameters referring to OC equal to zero ($\alpha_e, \alpha_d, \alpha_c, \beta, \beta_l, \beta_l, \beta_k, c_d$), Eq. (18) allows us to obtain the equilibrium value of g^* .

$$g^* = \gamma + \gamma_u u^* \tag{19}$$

With the algebraic manipulation of Eqs. (18–19), we obtain the following result:

Proposition 7.: *The equilibrium value of the capital stock growth rate in an economy without OC (g^*) is greater than the equilibrium value in an economy with OC (\tilde{g}) only if the reduction in investments connected to a lower level of economic activity exceeds the rise in investments fuelled by laundered criminal income.*

$$g^* > \tilde{g} \Rightarrow \gamma_u(u^* - \tilde{u}) > \beta_k(1 - \beta_l)\beta\epsilon\tilde{u}a_k \tag{20}$$

Proof of Proposition 7 in Appendix A.

In expression (20), the term $\gamma_u(u^* - \tilde{u})$ denotes the indirect influence of criminal organisations on the growth rate (\tilde{g}), which will be negative if they negatively affect the level of economic activity, that is, if inequality (16) holds; otherwise, the term $\beta_k(1 - \beta_l)\beta\epsilon\tilde{u}a_k$ identifies the direct influence of criminal organisations on the growth rate (\tilde{g}) through their investment decisions, which will always be positive. OC negatively affects the growth process when inequality (20) holds: the decrease in the growth rate resulting from a lower level of economic activity, i.e., the first term, exceeds the increase in the growth rate fuelled by money laundering, i.e., the second term.

By differentiating Eq. (18) with respect to the parameters, we obtain the following result:

Proposition 8.: *The capital stock growth rate (\tilde{g}) is positively influenced by $\alpha_d, \beta_l, \beta_k$ and c , whereas the effect of $\alpha_e, \alpha_c, \beta_l, \beta, \tau$ and c_d is uncertain. Except for β_l , the conditions implying a positive effect are less stringent compared to those required for the degree of capacity utilisation.*

Proof of Proposition (8) in Appendix A.

The share of criminal trade turnover not used to import criminal goods from abroad (α_d), the propensity to consume criminal goods out of non-laundered income (β_d) and the propensity to consume out of legal income (c) are positively related to the relative size of the criminal sector (ϵ) and to the degree of capacity utilisation (\tilde{u}), such that they positively influence the growth rate (\tilde{g}) through these channels. The extortion rate (α_e), the tax share diverted through the corruption of the public officials (α_c) and the share of the consumption of criminal goods in total consumption c_d are positively related to the relative size of the criminal sector (ϵ), but they may be negatively related to the degree of capacity utilisation (\tilde{u}). Hence, the positive impact on the growth rate (\tilde{g}) is observed only when the increase in the level of legal investments by OC offsets the decrease in the level of legal investments by firms, that is, if the positive effect associated with the second channel exceeds the negative effect connected to the first. The same arguments hold for the changes in the tax rate (τ), considering, however, that this parameter may also be negatively correlated with the relative size of the criminal sector (ϵ). Additionally, the effect of criminal income share to be laundered (β) on the growth rate (\tilde{g}) is uncertain: it is negatively related to the relative size of the criminal sector (ϵ), but may be positively related to the degree of capacity utilisation (\tilde{u}).¹⁶ Regarding the propensity to consume legal goods out of laundered income (β_l): it tends, on one hand, to increase the degree of capacity utilisation (\tilde{u}) through the demand for the consumption of legal goods, and, on the other hand, to decrease the growth rate (\tilde{g}) through a lower demand for legal investments, such that the overall impact is uncertain. By contrast, the propensity to invest in legal activities out of laundered income (β_k) is positively related to both the degree of capacity utilisation (\tilde{u}) and the growth rate (\tilde{g}), because it raises the legal investments arising from criminal income. In summary, OC can induce divergent dynamics in the level of economic activity and the growth process, promoting only notionally the latter: against an increase in the growth rate (\tilde{g}), a contraction in the degree of capacity utilisation (\tilde{u}) can be observed.

3.6. Summary of theoretical results

Overall, the theoretical model shows that OC may positively or negatively affect economic performance, depending on whether it results in an expansion or a contraction in the level of effective demand, in other words, depending on whether the decrease in effective demand entailed by extortion, the trade in criminal goods and corruption is greater or smaller than the increase in effective demand fuelled by money laundering. From the analytical perspective,

¹⁶ Note that $\tilde{Y}/K = a_k \epsilon u$, such that an increase in the level of legal investments by OC may be observed only if the opposite changes in ϵ and u lead to an increase in the absolute level of \tilde{Y} .

the net effect is uncertain, depending on the value of the parameters; more specifically, the following theoretical results identify the conditions under which criminal organisations negatively influence the level of economic activity and the growth process:

Theoretical result 1. *The relative size of the criminal sector with respect to the legal sector is greater than zero ($\varepsilon > 0$), such that the workings of OC determine income outflows from the legal sector through the crimes of extortion, trade in criminal goods and corruption (Proposition 1).*

Theoretical result 2. *The workings of OC negatively affect the level of economic activity ($u^* > \tilde{u}$), such that the reduction in the consumption of legal goods and public expenditures, connected to the crimes of extortion, trade in criminal goods and corruption, exceeds the rise in the consumption of legal goods and investment in legal activities fuelled by laundered criminal income (Propositions 3 and 4).*

Theoretical result 3. *The workings of OC negatively affect the growth process ($g^* > \tilde{g}$), such that the reduction in investments connected to a lower level of economic activity exceeds the rise in investments fuelled by laundered criminal income (Propositions 6 and 7).*

In the next section, to detect the actual impact of criminal organisations on the economy, we propose a simulation exercise that considers Italy, by testing Theoretical results (1, 2 and 3) against Italian data. The aim of this simulation is to calculate the ratio of criminal income to legal income (ε), and to assess whether and to what extent criminal organisations determine a negative effect on the degree of capacity utilisation (u) and the capital stock growth rate (g).

4. A simulation exercise: the case of Italy

This section proposes a simulation exercise that refers to the economy of Italy, where the presence of OC is regrettably known for its severe economic impact.¹⁷ Furthermore, Italy lends itself to this type of analysis because of a certain availability of relevant empirical data, but the exercise can be easily extended to other countries and can serve as the basis for cross country comparison.

The simulation exercise related to Italy aims to detect the actual influence of OC on the level of economic activity and the growth process in this country. As a first step, Section 4.1 describes the calibration procedure based on two alternative scenarios, one including and one excluding the presence of criminal organisations. Subsequently, Section 4.2 verifies Theoretical results (1, 2 and 3) for the Italian economy, such that we can conclude that criminal organisations determine a negative effect on the level of economic activity and the growth process. Then, Section 4.3 investigates which parameters have a greater impact on the endogenous variables and what is the actual sign of the parameters that ex ante present an uncertain effect according to the model predictions; moreover, a robustness test is also performed to check to what extent the results are sensitive to changes in the parameter values. Finally, Section 4.4 concludes with some policy recommendations.

4.1. The estimation of the parameters

The model presented in Section (3) includes three endogenous variables (ε , u , g) and thirteen parameters (α_c , α_d , α_c , β , β_d , β_l , β_k , τ , c , c_d , γ , γ_u , a_k), whose values reflect, whenever possible, those indicated in the relevant literature, whereas for some parameters for which there is a

¹⁷To cite some examples, by using the synthetic control method, Pinotti (2015) estimates that in two southern Italian regions and for a cumulative period of 20 years the loss in GDP per capita due to the presence of OC was 16 per cent. Nevertheless, the empirical literature also shows that criminal organisations can have a negative effect on the level of Italian regional income but not on the growth process (Mauro and Carmeci, 2007) and that the negative impact of crime on Italian economic performance can be stronger during recession than during expansion (Detotto and Otranto, 2010).

complete lack of data, some plausible conjectures are provided. For a summary of the value of the parameters, their definition and their source, see Table 1.

To assess the impact of OC, the calibration procedure builds on two alternative scenarios of the Italian economy. The first is a benchmark scenario, which describes an economy without the criminal sector and where c , τ , a_k , γ and γ_u are the only non-zero parameters (Eqs. 15 and 19). Parameters c , τ , and a_k are estimated using 1989–2008 averages related to the Italian economy and extracted from AMECO.¹⁸ Regarding the parameters of the investment function, we set a value of 0.0240 for γ and a value of 0.0246 for γ_u to obtain a net capital formation equal to 2.0 per cent when u is 80.0 per cent.¹⁹

The second is a criminal scenario described by the parameters α_c , α_d , α_c , β , β_l , β_d , β_k , and c_d , defining the economic profile of the criminal sector (Eqs. 13, 14 and 18). The values of α_c and c_d are set at 0.45 per cent and 6.57 per cent, which are the average values of the estimates performed by Calderoni (2014) and SOS Impresa-Confesercenti (2011).²⁰ With regard to the laundered share of criminal income, Ardizzi et al. (2012; 2014a) estimate the income produced by the illegal economy to be 10.9 per cent of GDP, and Ardizzi et al. (2014b) find that the money laundering attributable to the illegal economy is approximately 6.5 per cent of GDP.²¹ Assuming the same behaviour for the criminal organisations, a value for β of 60.1 per cent may be conjectured. Based on several case studies related to Dutch criminals, Unger (2007) provides some information about β_l : criminals show a propensity to consume legal goods out of laundered income of 28.2 per cent. Nevertheless, this estimate seems very low compared to the propensity to consume out of legal income, such that we prefer to assume the same value detected for the legal sector ($c(1 - c_d) = \beta_l$), i.e., 76.2 per cent. Similarly, we proceed for β_d ($cc_d/(1 - \beta) = \beta_d$), assuming the value of 13.4 per cent.²² A possible estimate of β_k is also provided by Unger (2007), for whom the criminals' propensity to invest is 50.4 per cent. For the parameters α_d and α_c , due to a complete lack of data in the literature, we conjecture a very high value for the share of criminal trade turnover not used to import criminal goods from abroad (95.0 per cent) and a low value for corruption revenues (0.1 per cent of tax revenues).²³

¹⁸ AMECO is the annual macroeconomic database of the European Commission's Directorate General for Economic and Financial Affairs, last accessed on 31 May 2016. More specifically, to calculate c we used the gross saving rate of households and non-profit institutions that serve households (AMECO code: ASGH); τ is the sum of social transfers in kind (AMECO code: UCIGO), the final consumption expenditure of the general government (AMECO code: UCTGO) and the gross fixed capital formation (AMECO code: UIGGO) expressed as percentages of GDP at current prices; a_k is the gross domestic product at the 2010 reference level per unit of net capital stock (or capital productivity) (AMECO code: AVGDK).

¹⁹As a first attempt, we calibrated the values of γ and γ_u to obtain the typically assumed value for u equal to 80.0 per cent. In this context, the model produces a value of 4.4 per cent for g against its historical average equal to 7.0 per cent; nevertheless, this value is related to the gross fixed capital formation, whereas the net fixed capital formation is 2.0 per cent. As a second attempt, we set a value of 0.0240 for γ , representing a capital stock depreciation rate of 2.4 per cent, and a value of 0.0246 for γ_u to obtain a net capital formation equal to 2.0 per cent when u is 80.0 per cent. Thus, the values used for the simulation exercise, compared to those of the actual Italian economy, differ only in underestimating the investment to restore the capital no longer in use.

²⁰Here, the trade in criminal goods refers to the following activities (Calderoni, 2014; SOS Impresa-Confesercenti, 2011): the sexual exploitation of women, illicit firearms trafficking, drug trafficking, the counterfeiting of goods, the illicit cigarette trade, illicit gambling and illicit waste disposal. Note that the estimates of revenues deriving from these criminal economic activities differ considerably: 0.6 per cent in Calderoni (2014) against 12.6 per cent in SOS Impresa-Confesercenti (2011). SOS Impresa and Confesercenti are associations of retailers; since 1995, they have published an annual report on the economy of OC.

²¹For the definition of the illegal economy, see note 6.

²²The actual values of β_l may be lower than the propensities to consume out of legal income: nonetheless, in the simulation exercise, our results do not significantly change with a lower value of β_l .

²³Additional information about the calibration procedure is available upon request from the authors.

4.2. The impact of OC on the Italian economy

In this section, by comparing the benchmark scenario to the criminal scenario, we test Theoretical results (1, 2 and 3) to investigate the actual influence of OC on the performance of the Italian economy. As a general result, we detect a negative impact on the Italian economy: a) the relative size of the criminal sector with respect to the legal sector is greater than zero ($\epsilon > 0$), 4.1 per cent of legal income (Theoretical result (1)); b) a lower degree of capacity utilisation ($u^* > \tilde{u}$), from 80.1 to 63.3 per cent (Theoretical result (2)); and c) a lower capital stock growth rate ($g^* > \tilde{g}$), from 4.4 to 4.0 per cent (Theoretical result (3)).

According to Theoretical result (1) and Proposition (1), the relative size of the criminal sector with respect to the legal sector is greater than zero ($\epsilon > 0$), if OC determines income outflows from the legal sector through the crimes of extortion, trade in criminal goods and corruption. The simulation exercise allows us to find that legal income outflows from the legal sector amount to 3.9 per cent of legal income and that the criminal income multiplier is equal to 1.05; as a result, we obtain a value of 4.1 per cent for the relative size of the criminal sector with respect to the legal sector (ϵ). What most contributes to determining this value is the trade in criminal goods (88.0 per cent), whereas extortion and corruption only play a marginal role (11.0 and 1.0 per cent, respectively) (Fig. 2). These findings seem to be reasonable: the size of the overall illegal sector, including not only that of criminal organisations, has been estimated by the literature to range between 1.5 per cent of GDP (Calderoni, 2014) and 10.9 of GDP (Ardizzi et al., 2012; 2014a) depending on the value attributed to drug revenues.

According to Theoretical result (2) and Propositions (3 and 4), OC negatively affects the level of economic activity ($u^* > \tilde{u}$), if the reduction in the consumption of legal goods and public expenditures, connected to the crimes of extortion, trade in criminal goods and corruption, exceeds the rise in the consumption of legal goods and investments in legal activities fuelled by laundered criminal income. For the Italian economy, we find that the decrease in consumptions and public expenditures amounts to 4.0 per cent of legal income, whereas the increase in effective demand fuelled by laundered criminal income is equal to 1.6 per cent of legal income (Eq. 16). As a result, the simulation exercise allows us to detect a negative impact of criminal organisations on the level of economic activity: a decrease in the degree of capacity utilisation of 21.0 per cent, from 80.1 to 63.3 (Eqs. 14 and 15); in terms of our model, a contraction in the level of economic activity of 21.0 per cent is equivalent to a decrease in GDP of the same amount.

According to Theoretical result (3) and Propositions (6 and 7), OC negatively affects the growth process ($g^* > \tilde{g}$), if the reduction in investments connected to a lower level of economic activity exceeds the rise in investments fuelled by laundered criminal income. For the Italian economy, we find that the decrease in investments related to the level of economic activity amounts to 0.41 per cent of the capital stock, whereas the increase in investments related to money laundering is equal to 0.08 per cent of the capital stock (Eq. 20). As a result, the simulation exercise allows us to detect a negative impact of criminal organisations on the growth process: a decrease in the capital stock growth rate of 7.6 per cent, from 4.4 to 4.0 (Eqs. 18 and 19).

Overall, for the Italian economy, we observe that the conditions identified by Theoretical results (1, 2 and 3) are satisfied, such that we can conclude that the workings of OC determine a negative influence on both the level of economic activity and the growth process: a contraction in the degree of capacity utilisation of 21.0 per cent and in the capital stock growth rate of 7.6 per cent; thus, having a larger impact on the level of economic activity, rather than on the growth process. These findings are comparable to those by Pinotti (2015), for whom, over a period of 20 years, the loss in GDP per capita due to the presence of OC is estimated at 16 per cent. Moreover, in Italy, from 1989 to 2008, there was a lower growth rate of GDP than that of capital stock (1.5 vs. 2.0 per cent), with a decrease in the ratio of GDP to the net

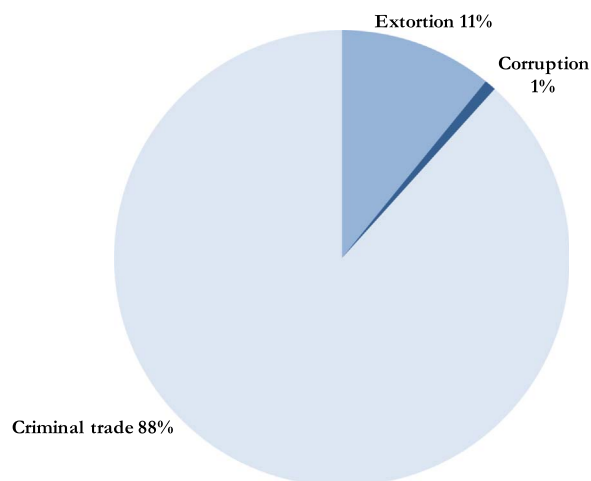


Fig. 2. The contribution of extortion, trade in criminal goods and corruption to the determination of ϵ .

Source: Authors' elaboration based on the parameters described in Table 1.

capital stock. This phenomenon is not widely observed in the economies of the Economic and Monetary Union.

4.3. The role of the parameters

The previous results depend on the assumptions made concerning the parameter values. To detect which parameters have a greater impact on the performance of the Italian economy, and what is the actual sign of the parameters that ex ante present an uncertain effect according to Propositions (2, 6 and 8), we calculate the elasticities of the relative size of the criminal sector (ϵ), the degree of capacity utilisation (u) and the growth rate (g) with respect to each parameter. To describe our results, we consider, first, the parameters related to the production of criminal income and, second, those related to its allocation. Table 2 makes it possible to compare the model predictions with the values of the elasticities, as computed through the simulation. The computation of the elasticities can also be used as a robustness test: in the equilibrium state, except for the propensity to consume both legal and criminal goods out of legal income (c), all elasticity values are less than one, such that we find no sign of an abnormal reaction of the endogenous variables to changes in the parameter values.

Focusing on criminal income production, the trade in criminal goods is the main offence affecting the legal sector. The share of criminal trade turnover not used to import criminal goods (α_d) and the share of the consumption of criminal goods in total consumption (c_d) show the highest elasticity values, with c_d that negatively influences the level of economic activity and the growth process. In more detail, the negative effect of criminal trade revenues on the legal sector disappears if c_d tends towards its lower bound (0.6 per cent according to Calderoni, 2014); by contrast, if it tends towards its upper bound (12.6 per cent according to SOS Impresa-Confesercenti, 2011), the relative size of the criminal sector (ϵ), the degree of capacity utilisation (\tilde{u}) and the growth rate (\tilde{g}) become equal to 53.7, 3.9 and 7.4 per cent, respectively. Otherwise, extortion (α_e) and corruption (α_c) negatively impact Italian economic performance, but their effect is negligible. Substantially, the picture represented in Fig. 2 also holds for the level of economic activity and the growth process.

Regarding the allocation of criminal income, the main intuition of the paper is as follows: given the income outflows from the legal sector, the impact of OC on the level of economic activity and the growth process depends on the interaction between the relative size of the criminal sector (ϵ) and the criminal income share laundered in the legal sector (β). Fig. 3 displays this interaction.

The relative size of the criminal sector (ϵ) tends to decrease as the share of laundered income increases (β): indeed, laundered income is

Table 2

Relationships between ε , u , and g and the parameters.
Source: Authors' elaboration based on the parameters described in Table 1.

	The sign of the relationship, as predicted by the model			The value of the elasticity, as computed through the simulation		
	ε	u	g	ε	u	g
α_e extortion rate	+	\pm	\pm	0.1088	-0.0120	-0.0027
α_d share of criminal trade turnover not used to import criminal goods	+	+	+	0.9307	0.2338	0.1138
α_c tax share diverted through corruption	+	\pm	\pm	0.0081	-0.0016	-0.0005
β laundered share of criminal income	-	\pm	\pm	-0.0806	0.2310	0.1124
β_d propensity to consume criminal goods out of non-laundered income	+	+	+	0.0535	0.0135	0.0065
β_l propensity to consume legal goods out of laundered income		+	\pm		0.1076	-0.0214
β_k propensity to invest in real activities out of laundered income		+	+		0.0342	0.0342
τ tax rate	\pm	\pm	\pm	-0.4061	0.7648	0.3021
c propensity to consume both legal and criminal goods out of legal income	+	+	+	0.8772	6.0928	2.4899
c_d share of the consumption of criminal goods in total consumption	+	\pm	\pm	0.8772	-0.1952	-0.0614

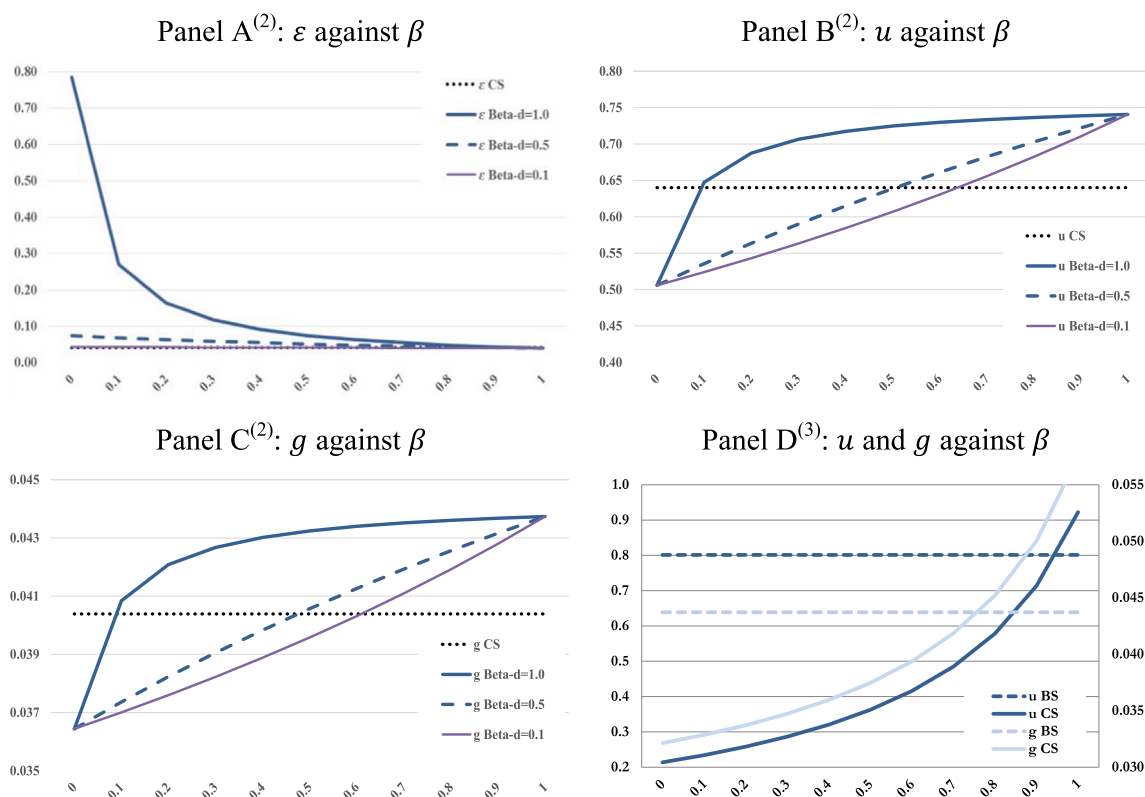


Fig. 3. The effect of money laundering (β) on ε , u , and g ⁽¹⁾. Note (1): The curves reflect the values of ε , u , and g against β , as calculated in Eqs. (13, 14 and 18). Note (2): In Panels A, B and C, the criminal scenario curves (CS) are based on the parameters described in Table 1, whereas the remaining curves reflect the hypothesis that β_d is equal to 0.1, 0.5 and 1, respectively; the endogenous variable is represented on the Y-Axis and β on the X-Axis. Note (3): In Panel D, the criminal scenario curves (CS) and the benchmark scenario curves (BS) are based on the parameters described in Table 1, except for α_e , which is assumed to be 20.0 per cent; u and g are represented on the left Y-Axis and right Y-Axis, respectively, and β on the X-Axis.

Source: Authors' elaboration based on the parameters described in Table 1.

introduced back into the legal sector through investment in legal activities and the consumption of legal goods (Fig. 3, Panel A). For low values of the propensity to consume criminal goods out of non-laundered income (β_d), the equilibrium level of ε is low, and the two curves showing the relationship between ε and β are very flat; by contrast, when β_d tends towards 1, ε is high, for a value of β falling in the range of 0.0-0.2, but it quickly decreases with an increase in β . In

the extreme case where β is 0 and β_d is 1, ceteris paribus, the criminal income multiplier rises, and ε tends towards $+\infty$, which means that the criminal sector becomes much greater than the legal sector.

For the Italian economy, despite the uncertain relationship displayed by the theoretical model, the criminal income share to be laundered (β) is positively related to the degree of capacity utilisation (\hat{u}) and the growth rate (\hat{g}): an increase in β from 0.0 to 1.0 produces a

rise in \tilde{u} and \tilde{g} , from 50.6 to 74.1 and from 3.6 to 4.4 per cent, respectively (Fig. 3, panels B and C). Note that when the relative size of the criminal sector (ε) is greater, i.e., when the propensity to consume criminal goods out of non-laundered income (β_d) tends towards 1, we obtain a decreasing marginal effect of β on \tilde{u} and \tilde{g} ; differently, when ε is lower, i.e., when β_d tends towards 0, we obtain an increasing marginal effect of β . The economic intuition is as follows: when β_d is high and β is low, the criminal income multiplier raises the size of the criminal sector, such that an increase in β produces a larger marginal effect on \tilde{u} and \tilde{g} , which decreases with the reduction in criminal income. Furthermore, the elasticities of the degree of capacity utilisation (\tilde{u}) and the growth rate (\tilde{g}) with respect to β are also larger than those of the other parameters describing the allocation of criminal income. The propensity to consume criminal goods out of non-laundered income (β_d) and the propensity to invest in real activities out of laundered income (β_k) positively affect both \tilde{u} and \tilde{g} , whereas the propensity to consume legal goods out of laundered income (β_l) is positively related to \tilde{u} , but negatively to \tilde{g} . Thus, money laundering seems to be a key factor in determining to what extent OC can affect the Italian economy.

Assuming an extortion rate (α_e) of 0.20 allows us to show the conditions under which the workings of OC can positively affect Italian economic performance (Fig. 3, Panel D). As a result of the change in the share of the criminal income to be laundered (β), if β is sufficiently high, then we can detect values of the degree of capacity utilisation (\tilde{u}) and the growth rate (\tilde{g}) that exceed those observed in the benchmark scenario, defining a positive effect of the workings of OC on the legal sector. Moreover, because a lower value of β is needed to obtain a greater value of \tilde{g} with respect to the benchmark scenario, it is confirmed that the conditions for a positive effect of criminal organisations on \tilde{u} are more binding compared to those related to \tilde{g} .

4.4. Policy recommendations

The results of the simulation exercise identify the main factors that determine how OC can affect the Italian economy; therefore, they allow us to make some suggestions concerning public policy against OC.

First, on the production side, criminal trade revenues appear to play a key role in determining the relative size of the criminal sector; in terms of the analytical model, we refer to the parameter c_d . Public policy against OC should focus on an in-depth investigation into the economic activities connected to criminal organisations, also promoting the emergence of such economic activities into the legal sector. Moreover, given the lack of information on this phenomenon, institutions should promote an enhanced understanding of the real dimension of the criminal trade, allowing clarification on this issue.

Second, on the allocation side, although it is a crime, money laundering plays a key role in amplifying or dampening the negative impact of criminal organisations on the level of economic activity and the growth process; in terms of our model, we refer to parameter β . Public policy against OC should also consist of a money laundering policy to promote the reintroduction of criminal income into the legal sector. To date, without such a strategy, the policies against OC, mainly focusing on the matter of criminal income generation, have shown little effect in mitigating the negative impact of criminal organisations on the economy.

Appendix A.

A.1. Proof of Proposition 1

By substituting expressions (8–10) in Eq. (7), we can obtain Eq. (13).

$$\tilde{Y} = \alpha_e Y + \alpha_d [c_d c (1 - \alpha_e - \tau) Y + \beta_d (1 - \beta) \tilde{Y}] + \alpha_c \tau Y$$

5. Conclusions

The post-Keynesian literature, in addition to the OC literature, contains no analytical framework that captures the complexity of the effects that the presence of OC generates on the level of economic activity and the growth process. This paper fills this gap within a post-Keynesian model, where we simultaneously study the economic effects of extortion, the trade in criminal goods, corruption and money laundering and where we distinguish the overall impact of OC on aggregate demand between the effects on consumption and investment.

The results of the theoretical model are as follows. First, the relative size of the criminal sector with respect to the legal sector depends on the size of the legal income outflows from the legal sector and the criminal income multiplier. Second, the impact of OC on the level of economic activity and the growth process is uncertain: it will be negative only if the decrease in effective demand resulting from the crimes of extortion, criminal trade and corruption is not offset by the increase in effective demand fuelled by money laundering, i.e., if laundered income does not sufficiently support the level of consumption and investment and the consumption of criminal goods along with precautionary savings to absorb a sufficient share of the criminal income. Third, the investment decisions of firms are related to both the degree of capacity utilisation and the amount of criminal income, such that the conditions to be satisfied to obtain a positive impact of criminal organisations on the capital stock growth rate are less binding than those for the degree of capacity utilisation.

For the Italian economy, the simulation exercise detects a negative effect of OC on the level of the economic activity and the growth process, with a key role played by the trade in criminal goods and money laundering. Thus, in this country, any public policy against the OC should mainly focus on these aspects to mitigate the negative impact of criminal organisations on the economy.

The results of the simulation exercise raise interesting new theoretical and empirical issues. For instance, how do the workings of OC affect the level of economic activity and the growth process of the regions belonging to the same country? When income flows related to both the legal sector and the workings of criminal organisations connect one region to another, then the differences in the relative size of the criminal sector can affect their economic dynamics. Again, to what extent do the trade in criminal goods and money laundering play a key role in determining the effect of OC in other countries? Other criminal organisations can differ from those in Italy with respect to the substance of their typical crimes, such that suggestions regarding the public policy to combat OC can also change.

Acknowledgements

We gratefully acknowledge the helpful comments by the participants at the 53rd Annual Conference of the Italian Economic Association and the 24th Annual Conference of the ‘Società Italiana di Economia Pubblica’. We also acknowledge the helpful comments by the three anonymous referees.

$$\tilde{Y} - \alpha_d \beta_d (1 - \beta) \tilde{Y} = \alpha_e Y + \alpha_d c_d c (1 - \alpha_e - \tau) Y + \alpha_c \tau Y$$

$$\tilde{Y} [1 - \alpha_d \beta_d (1 - \beta)] = Y [\alpha_e + \alpha_d c_d c (1 - \alpha_e - \tau) + \alpha_c \tau]$$

$$\varepsilon = \frac{\tilde{Y}}{Y} = \frac{\alpha_e + \alpha_d c_d c (1 - \alpha_e - \tau) + \alpha_c \tau}{1 - \alpha_d \beta_d (1 - \beta)}$$

A.2. Proof of Proposition 2

By differentiating expression (13) with respect to the set of parameters $(\alpha_e, \alpha_d, \alpha_c, \beta, \beta_l, \beta_d, \beta_k, \tau, c, c_d)$, we can obtain the following inequalities.

$$\frac{\partial \varepsilon}{\partial \alpha_e} = \frac{1 - \alpha_d c_d c}{1 - \alpha_d \beta_d (1 - \beta)} > 0$$

$$\begin{aligned} \frac{\partial \varepsilon}{\partial \alpha_d} &= \frac{c_d c (1 - \alpha_e - \tau) [1 - \alpha_d \beta_d (1 - \beta)] - [\alpha_e + \alpha_d c_d c (1 - \alpha_e - \tau) + \alpha_c \tau] [-\beta_d (1 - \beta)]}{[1 - \alpha_d \beta_d (1 - \beta)]^2} = \\ &= \frac{c_d c (1 - \alpha_e - \tau) - [\alpha_d c_d c (1 - \alpha_e - \tau) \beta_d (1 - \beta)] - [\alpha_c \beta_d (1 - \beta) + \alpha_d c_d c (1 - \alpha_e - \tau) \beta_d (1 - \beta) + \alpha_c \tau \beta_d (1 - \beta)]}{[1 - \alpha_d \beta_d (1 - \beta)]^2} = \end{aligned}$$

$$= \frac{c_d c (1 - \alpha_e - \tau) + (\alpha_e + \alpha_c \tau) \beta_d (1 - \beta)}{[1 - \alpha_d \beta_d (1 - \beta)]^2} > 0$$

$$\frac{\partial \varepsilon}{\partial \alpha_c} = \frac{\tau}{1 - \alpha_d \beta_d (1 - \beta)} > 0$$

$$\frac{\partial \varepsilon}{\partial \beta} = \frac{-\alpha_d \beta_d [\alpha_e + \alpha_d c_d c (1 - \alpha_e - \tau) + \alpha_c \tau]}{[1 - \alpha_d \beta_d (1 - \beta)]^2} < 0$$

$$\frac{\partial \varepsilon}{\partial \beta_d} = \frac{\alpha_d (1 - \beta) [\alpha_e + \alpha_d c_d c (1 - \alpha_e - \tau) + \alpha_c \tau]}{[1 - \alpha_d \beta_d (1 - \beta)]^2} > 0$$

$$\frac{\partial \varepsilon}{\partial \tau} = \frac{\alpha_c - \alpha_d c_d c}{1 - \alpha_d \beta_d (1 - \beta)} > 0 \text{ if } \alpha_c > \alpha_d c_d c$$

$$\frac{\partial \varepsilon}{\partial c} = \frac{\alpha_d c_d (1 - \alpha_e - \tau)}{1 - \alpha_d \beta_d (1 - \beta)} > 0$$

$$\frac{\partial \varepsilon}{\partial c_o} = \frac{\alpha_d c (1 - \alpha_e - \tau)}{1 - \alpha_d \beta_d (1 - \beta)} > 0$$

A.3. Proof of Proposition 3

By considering the equilibrium condition $Y = Y_d$ and using Eqs. (1–4), we can obtain the following expressions.

$$Y = Y_d = C_l + I_l + G$$

$$Y = (1 - \alpha_e - \tau)(1 - c_d)cY + \beta_l \beta \tilde{Y} + I_l^l + \beta_k (1 - \beta_l) \beta \varepsilon Y + \tau Y (1 - \alpha_c)$$

By considering Eq. (13), we can obtain the following expression:

$$Y = (1 - \alpha_e - \tau)(1 - c_d)cY + \beta_l \beta \varepsilon Y + I_l^l + \beta_k (1 - \beta_l) \beta \varepsilon Y + \tau Y (1 - \alpha_c)$$

$$Y \{1 - (1 - \alpha_e - \tau)(1 - c_d)c - [\beta_l + \beta_k (1 - \beta_l)] \beta \varepsilon - (1 - \alpha_c) \tau\} = I_l^l$$

By dividing for K and considering Eqs. (5) and (6), we can obtain the equilibrium solution for \tilde{u} .

$$\frac{Y}{K} \frac{Y_p}{Y_p} \{1 - (1 - \alpha_e - \tau)(1 - c_d)c - [\beta_l + \beta_k (1 - \beta_l)] \beta \varepsilon - (1 - \alpha_c) \tau\} = \frac{I_l^l}{K}$$

$$u \alpha_k \{1 - (1 - \alpha_e - \tau)(1 - c_d)c - [\beta_l + \beta_k (1 - \beta_l)] \beta \varepsilon - (1 - \alpha_c) \tau\} = \gamma + \gamma_u u$$

$$u \alpha_k \{1 - (1 - \alpha_e - \tau)(1 - c_d)c - [\beta_l + \beta_k (1 - \beta_l)] \beta \varepsilon - (1 - \alpha_c) \tau\} - \gamma_u u = \gamma$$

$$\tilde{u} = \frac{\gamma}{\alpha_k \{1 - (1 - \alpha_e - \tau)(1 - c_d)c - [\beta_l + \beta_k (1 - \beta_l)] \beta \varepsilon - (1 - \alpha_c) \tau\} - \gamma_u}$$

A.4. Proof of Proposition 4

By comparing Eq. (14) to expression (15), we can obtain inequality (16).

$$u^* > \tilde{u}$$

$$\frac{\gamma}{a_k \{1 - (1 - \tau)c - \tau\} - \gamma_u} > \frac{\gamma}{a_k \{1 - (1 - \alpha_e - \tau)(1 - c_d)c - [\beta_l + \beta_k(1 - \beta_l)]\beta\varepsilon - (1 - \alpha_c)\tau\} - \gamma_u}$$

$$a_k \{1 - (1 - \alpha_e - \tau)(1 - c_d)c - [\beta_l + \beta_k(1 - \beta_l)]\beta\varepsilon - (1 - \alpha_c)\tau\} > a_k \{1 - (1 - \tau)c - \tau\}$$

$$-(1 - \alpha_e - \tau)(1 - c_d)c - [\beta_l + \beta_k(1 - \beta_l)]\beta\varepsilon - (1 - \alpha_c)\tau > -(1 - \tau)c - \tau$$

$$-(1 - \alpha_e - \tau)(1 - c_d)c + (1 - \tau)c + \tau - (1 - \alpha_c)\tau > [\beta_l + \beta_k(1 - \beta_l)]\beta\varepsilon$$

$$[-(1 - \alpha_e - \tau)(1 - c_d) + (1 - \tau)]c + \alpha_c\tau > [\beta_l + \beta_k(1 - \beta_l)]\beta\varepsilon$$

$$[\alpha_e + (1 - \alpha_e - \tau)c_d]c + \alpha_c\tau > [\beta_l + \beta_k(1 - \beta_l)]\beta\varepsilon$$

A.5. Proof of Proposition 5

By differentiating expression (14) with respect to the set of parameters $(\alpha_e, \alpha_d, \alpha_c, \beta, \beta_l, \beta_d, \beta_k, \tau, c, c_d)$, we can obtain the following inequalities.

$$\frac{\partial \tilde{u}}{\partial \alpha_e} = \frac{-\left\{ (1 - c_d)c - [\beta_l + \beta_k(1 - \beta_l)]\beta \frac{\partial \varepsilon}{\partial \alpha_e} \right\} a_k \gamma}{\{a_k \{1 - (1 - \alpha_e - \tau)(1 - c_d)c - [\beta_l + \beta_k(1 - \beta_l)]\beta\varepsilon - (1 - \alpha_c)\tau\} - \gamma_u\}^2} > 0$$

if $[\beta_l + \beta_k(1 - \beta_l)]\beta \frac{\partial \varepsilon}{\partial \alpha_e} > (1 - c_d)c$

$$\frac{\partial \tilde{u}}{\partial \alpha_d} = \frac{\left\{ [\beta_l + \beta_k(1 - \beta_l)]\beta \frac{\partial \varepsilon}{\partial \alpha_d} \right\} a_k \gamma}{\{a_k \{1 - (1 - \alpha_e - \tau)(1 - c_d)c - [\beta_l + \beta_k(1 - \beta_l)]\beta\varepsilon - (1 - \alpha_c)\tau\} - \gamma_u\}^2} > 0$$

$$\frac{\partial \tilde{u}}{\partial \alpha_c} = \frac{-\left\{ \tau - [\beta_l + \beta_k(1 - \beta_l)]\beta \frac{\partial \varepsilon}{\partial \alpha_c} \right\} a_k \gamma}{\{a_k \{1 - (1 - \alpha_e - \tau)(1 - c_d)c - [\beta_l + \beta_k(1 - \beta_l)]\beta\varepsilon - (1 - \alpha_c)\tau\} - \gamma_u\}^2} > 0$$

if $[\beta_l + \beta_k(1 - \beta_l)]\beta \frac{\partial \varepsilon}{\partial \alpha_c} > \tau$

$$\frac{\partial \tilde{u}}{\partial \beta} = \frac{-\left\{ -[\beta_l + \beta_k(1 - \beta_l)] \left[\varepsilon + \beta \frac{\partial \varepsilon}{\partial \beta} \right] \right\} a_k \gamma}{\{a_k \{1 - (1 - \alpha_e - \tau)(1 - c_d)c - [\beta_l + \beta_k(1 - \beta_l)]\beta\varepsilon - (1 - \alpha_c)\tau\} - \gamma_u\}^2} > 0$$

if $\varepsilon > \beta \frac{\partial \varepsilon}{\partial \beta}$

$$\frac{\partial \tilde{u}}{\partial \beta_l} = \frac{[(1 - \beta_k)\beta\varepsilon] a_k \gamma}{\{a_k \{1 - (1 - \alpha_e - \tau)(1 - c_d)c - [\beta_l + \beta_k(1 - \beta_l)]\beta\varepsilon - (1 - \alpha_c)\tau\} - \gamma_u\}^2} > 0$$

$$\frac{\partial \tilde{u}}{\partial \beta_d} = \frac{\left\{ [\beta_l + \beta_k(1 - \beta_l)]\beta \frac{\partial \varepsilon}{\partial \beta_d} \right\} a_k \gamma}{\{a_k \{1 - (1 - \alpha_e - \tau)(1 - c_d)c - [\beta_l + \beta_k(1 - \beta_l)]\beta\varepsilon - (1 - \alpha_c)\tau\} - \gamma_u\}^2} > 0$$

$$\frac{\partial \tilde{u}}{\partial \beta_k} = \frac{[(1 - \beta_l)\beta\varepsilon] a_k \gamma}{\{a_k \{1 - (1 - \alpha_e - \tau)(1 - c_d)c - [\beta_l + \beta_k(1 - \beta_l)]\beta\varepsilon - (1 - \alpha_c)\tau\} - \gamma_u\}^2} > 0$$

$$\frac{\partial \tilde{u}}{\partial \tau} = \frac{\{[\beta_l + \beta_k(1 - \beta_l)]\beta \frac{\partial \varepsilon}{\partial \tau} + (1 - \alpha_c)\} a_k \gamma}{\{a_k \{1 - (1 - \alpha_e - \tau)(1 - c_d)c - [\beta_l + \beta_k(1 - \beta_l)]\beta\varepsilon - (1 - \alpha_c)\tau\} - \gamma_u\}^2} > 0$$

if $[\beta_l + \beta_k(1 - \beta_l)]\beta \frac{\partial \varepsilon}{\partial \tau} + (1 - \alpha_c) > 0$

$$\frac{\partial \tilde{u}}{\partial c} = \frac{\{(1 - \alpha_e - \tau)(1 - c_d) + [\beta_l + \beta_k(1 - \beta_l)]\beta \frac{\partial \varepsilon}{\partial c}\} a_k \gamma}{\{a_k \{1 - (1 - \alpha_e - \tau)(1 - c_d)c - [\beta_l + \beta_k(1 - \beta_l)]\beta\varepsilon - (1 - \alpha_c)\tau\} - \gamma_u\}^2} > 0$$

$$\frac{\partial \tilde{u}}{\partial c_d} = \frac{\{[\beta_l + \beta_k(1 - \beta_l)]\beta \frac{\partial \varepsilon}{\partial c} - (1 - \alpha_e - \tau)c\} a_k \gamma}{\{a_k \{1 - (1 - \alpha_e - \tau)(1 - c_d)c - [\beta_l + \beta_k(1 - \beta_l)]\beta\varepsilon - (1 - \alpha_c)\tau\} - \gamma_u\}^2} > 0$$

if $[\beta_l + \beta_k(1 - \beta_l)]\beta \frac{\partial \varepsilon}{\partial c} > (1 - \alpha_e - \tau)c$

A.6. Proof of Proposition 6

By considering Eqs. (3, 5, 13 and 17), and through a simple algebraic manipulation, we can obtain the equilibrium solution for \tilde{g} .

$$\tilde{g} = \frac{I_l^i + I_l^o}{K} = g_l^i + g_l^o = \gamma + \gamma_u u + \beta_k (1 - \beta_l) \beta \frac{\tilde{Y}}{K}$$

$$\tilde{g} = \gamma + \gamma_u u + \beta_k (1 - \beta_l) \beta \frac{\varepsilon Y Y_p}{K Y_p} = \gamma + \gamma_u u + \beta_k (1 - \beta_l) \beta \varepsilon u a_k$$

$$\tilde{g} = \gamma + \gamma_u \tilde{u} + \beta_k (1 - \beta_l) \beta \varepsilon \tilde{u} a_k$$

A.7. Proof of Proposition 7

By comparing Eq. (14) to expression (15), we can obtain inequality (16).

$$g^* > \tilde{g}$$

$$\gamma + \gamma_u u^* > \gamma + \gamma_u \tilde{u} + \beta_k (1 - \beta_l) \beta \varepsilon \tilde{u} a_k$$

$$\gamma_u (u^* - \tilde{u}) > \beta_k (1 - \beta_l) \beta \varepsilon \tilde{u} a_k$$

A.8. Proof of Proposition 8

By differentiating expression (18) with respect to the set of parameters $(\alpha_e, \alpha_d, \alpha_c, \beta, \beta_l, \beta_d, \beta_k, \tau, c, c_d)$, we can obtain the following inequalities.

$$\frac{\partial \tilde{g}}{\partial \alpha_e} = \gamma_u \frac{\partial \tilde{u}}{\partial \alpha_e} + \beta_k (1 - \beta_l) \beta a_k \left(\frac{\partial \varepsilon}{\partial \alpha_e} \tilde{u} + \varepsilon \frac{\partial \tilde{u}}{\partial \alpha_e} \right) \leq 0$$

$$\frac{\partial \tilde{g}}{\partial \alpha_d} = \gamma_u \frac{\partial \tilde{u}}{\partial \alpha_d} + \beta_k (1 - \beta_l) \beta a_k \left(\frac{\partial \varepsilon}{\partial \alpha_d} \tilde{u} + \varepsilon \frac{\partial \tilde{u}}{\partial \alpha_d} \right) > 0$$

$$\frac{\partial \tilde{g}}{\partial \alpha_c} = \gamma_u \frac{\partial \tilde{u}}{\partial \alpha_c} + \beta_k (1 - \beta_l) \beta a_k \left(\frac{\partial \varepsilon}{\partial \alpha_c} \tilde{u} + \varepsilon \frac{\partial \tilde{u}}{\partial \alpha_c} \right) \leq 0$$

$$\frac{\partial \tilde{g}}{\partial \beta} = \gamma_u \frac{\partial \tilde{u}}{\partial \beta} + \beta_k (1 - \beta_l) a_k \varepsilon \tilde{u} + \beta_k (1 - \beta_l) \beta a_k \left(\frac{\partial \varepsilon}{\partial \beta} \tilde{u} + \varepsilon \frac{\partial \tilde{u}}{\partial \beta} \right) \leq 0$$

$$\frac{\partial \tilde{g}}{\partial \beta_l} = \gamma_u \frac{\partial \tilde{u}}{\partial \beta_l} + \beta_k \beta \varepsilon a_k \left[(1 - \beta_l) \frac{\partial \tilde{u}}{\partial \beta_l} - \tilde{u} \right] \leq 0$$

$$\frac{\partial \tilde{g}}{\partial \beta_d} = \gamma_u \frac{\partial \tilde{u}}{\partial \beta_d} + \beta_k (1 - \beta_l) \beta a_k \left(\frac{\partial \varepsilon}{\partial \beta_d} \tilde{u} + \varepsilon \frac{\partial \tilde{u}}{\partial \beta_d} \right) \leq 0$$

$$\frac{\partial \tilde{g}}{\partial \beta_k} = \gamma_u \frac{\partial \tilde{u}}{\partial \beta_k} + (1 - \beta_l) \beta \varepsilon a_k \left(\tilde{u} + \beta_k \frac{\partial \tilde{u}}{\partial \beta_k} \right) > 0$$

$$\frac{\partial \tilde{g}}{\partial \tau} = \gamma_u \frac{\partial \tilde{u}}{\partial \tau} + \beta_k (1 - \beta_l) \beta a_k \left(\frac{\partial \varepsilon}{\partial \tau} \tilde{u} + \varepsilon \frac{\partial \tilde{u}}{\partial \tau} \right) \leq 0$$

$$\frac{\partial \tilde{g}}{\partial c} = \gamma_u \frac{\partial \tilde{u}}{\partial c} + \beta_k (1 - \beta_l) \beta a_k \left(\frac{\partial \varepsilon}{\partial c} \tilde{u} + \varepsilon \frac{\partial \tilde{u}}{\partial c} \right) > 0$$

$$\frac{\partial \tilde{g}}{\partial c_d} = \gamma_u \frac{\partial \tilde{u}}{\partial c_d} + \beta_k (1 - \beta_l) \beta a_k \left(\frac{\partial \varepsilon}{\partial c_d} \tilde{u} + \varepsilon \frac{\partial \tilde{u}}{\partial c_d} \right) \leq 0$$

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