Market and Political Power Interactions in Greece: A Theory

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January 20, 2017

Abstract: For nearly forty years, economic growth in Greece has been weak. Recently, moreover, this country is suffering from a persisting economic crisis that goes beyond the usual business cycle recessions. In this paper, we develop a neoclassical growth model of market and political power interactions that captures the main features of the economic and political system of Greece. The model incorporates the insiders-outsiders labor market structure and the concept of an elite government. Outsiders form a group of workers that supply labor to a competitive private sector. And, insiders form a group of workers that enjoy market power in supplying labor to the public sector and influence the policy decisions of government, including those that affect the development and maintenance of public sector infrastructures. This leads to labor misallocation and inefficient fiscal policies. Thus, despite the fact that expanding public sector output has a positive effect on growth, eventually this is counterbalanced by the labor misallocation and inefficient tax policy outcomes. The interaction of these effects, over time, explains the dismal growth performance of Greece and reveals as an important factor behind its present crisis, the existence of a growth reversal phenomenon. The model proposed in this paper may be applicable for other countries that have a similar politicoeconomic structure with Greece, namely other Southern European countries.

JEL classification: P16; O43; J45; O52
Keywords: Insiders - Outsiders; Politicoeconomic Equilibrium; Taxation; Fiscal Policy; Growth; Greek Crisis

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“Too many politicians and economists blame austerity – urged by Greece’s creditors – for the collapse of the Greek economy. But the data show neither marked austerity by historical standards nor government cutbacks severe enough to explain the huge job losses. What the data do show are economic ills rooted in the values and beliefs of Greek society. Greece’s public sector is rife with clientelism (to gain votes) and cronyism (to gain favors) – far more so than in other parts of Europe”.


1. INTRODUCTION

Plotted in Figures 1a and 1b, respectively, are the real per capita GDP and its smooth trend component, in Greece and the OECD average, since 1970.1 As shown in Figure 1a, the recession that plagued recently most OECD countries, was deeper and more protracted, in Greece, evolving to a genuine crisis. The economics profession largely regards the Greek crisis as a sovereign debt crisis, manifested in the unprecedented increase of the actual public debt to GDP ratio, depicted in Figure 2.2 There is no doubt, then, that a major contributor to this increase is the dismal growth performance of Greece, since the late seventies. The latter is not limited only to the negative growth since the beginning of the crisis, but also on the divergence in the GDP per capita path of Greece relative to that of the OECD average, since the late seventies.3 Also plotted in Figure 2 is what the public debt to GDP in Greece would have looked like in the counterfactual case where GDP after 1979 was growing at the OECD average rate. Clearly, the extremely high actual public debt to GDP ratio in Greece is a consequence of the prolonged weak growth, illustrated in Figure 1. In this paper, we develop a model that explains this divergent behavior of Greek GDP and the subsequent growth reversal in the years of the crisis. As a starting point, we should accept that such a model should be consistent with the underlying structure of the Greek economy.

1 See Data Appendix for data sources and methods.
2 The Greek sovereign debt crisis is manifested in the high and unsustainable levels of the debt to GDP ratio in the sense of Reinhart and Rogoff (2010). Blanchard (2015), for example, writes: “Even before the 2010 (first bailout) program, debt in Greece was 300 billion euros, or 130% of GDP. The deficit was 36 billion euros, or 15½ % of GDP. Debt was increasing at 12% a year, and this was clearly unsustainable”. This literature emphasizes various aspects of the causes and remedies of the deep recession, such as: debt dynamics (see, e.g., House and Tesar (2015) and Schumachers and Weder di Mauro (2015), external dependence and sudden stop issues (see, e.g., Gross (2013) and Reinhart and Trebesch (2015)), contagion effects (e.g., Mink and De Haan (2013)), political economy aspects of the policies selected by national, supranational and international institutions to deal with the crisis (see, e.g., DeGrawe (2013) and Ardagna and Caselli (2014)), bargaining outcomes in dealing with the crisis and the role of austerity (e.g., Zettelmeyer et al. (2013)) and the interaction between external government debt crisis and a bank run prolonging the ensuing recession (e.g., Arellano et al. (2015)). For a narrative of the Greek crisis see also Economides et al. (2016) and Bulow and Rogoff (2015).
The structure of the economic and political systems of Greece is characterized by a relatively large public sector, with basic networks and utility services provided by government and more importantly by agencies or firms that, on the one hand, are heavily regulated and, on the other hand, labor therein is organized in powerful independent unions.\footnote{Total government spending as a share to GDP in the pre-crisis year 2007 in Greece was 46.93%. This is not much higher relative to the Eurozone 15 average of 45.33, but considerably higher than the OECD average of 39.01.} \footnote{Moreover, there are important strategic}
interactions between these unions and the government that give rise to a high spending bias and consequently for high taxes and/or high debt accumulation. Figure 3 presents evidence on the importance of the role of the state and public sector unions in the economy. More specifically, Figure 3a plots OECD’s State Control index. This is a composite index incorporating information on the extend of public ownership, government involvement in network sectors, direct control over enterprises, governance of state owned enterprises and state’s involvement in business operations. Greece is characterized by the highest degree of state control, with the other Southern European countries making up the top five in the list. Figure 3b plots the ratio of the union densities in the public relative to the private sector, which is a proxy for the relative strength of public sector unions. Again, Greece ranks very high, surpassed only by three Anglo Saxon countries, where private sector union densities are relatively very low, while the picture of the other Southern European countries is mixed.

Figure 3. State Control Index and Union Density in the Public over the Private Sector

Note: Data sources and definitions in the Appendix.

However, it is not so much the size of the government that is in question, here, but the fact that the Greek state is widely taken to be one of the most interfering in the workings of the economy (See, e.g., the OECD study by Koske, et al. (2015)).

Chapter 1 of the “Industrial Relations in Europe 2012” extensive report of the European Commission (2013) places Greece along with other Southern European countries in the industrial relations system cluster, referred to as “state-centered.” And, in Chapter 3, the same cluster of countries is identified when it comes to public sector industrial relations. Similar classifications with respect to wage bargaining institutions have been made in Visser (2013) and European Commission (2014).

This interaction has been recognized in the political science literature since the late seventies (Schmitter (1977), Sargent (1985), Cawson (1986)) and recently has been explicitly pointed out for Greece by Featherstone (2008).

Further empirical evidence on the insiders – outsiders society structure of Greece and other countries is provided in Kollintzas et al. (2016).
In this paper, we develop a dynamic general equilibrium model of market and political power interactions, based on a synthesis of the insiders-outsiders labor market structure of Lindbeck and Snower (1986) and the concept of an elite government of Acemoglu (2006), as this elite coincides with the group of insiders. That is, we identify insiders as a group of workers that enjoy market power in supplying labor to the public sector and influence the policy decisions of government, including those that affect public finances through the development and maintenance of public sector infrastructures. And, we identify outsiders as a group of workers that supply labor to a competitive private sector. Thus, wages differ across identical labor services due to the particular organization of the labor market. Although insiders and outsiders are identical, the wages of insiders are higher than those of the outsiders, creating, what we call the “labor misallocation effect,” that lowers output and output growth towards the steady state.

More specifically, outsiders work on the production of a final good, while insiders work on the production of intermediate goods, produced by monopolies controlled by government. For that reason, intermediate goods enter the final goods production function through a Dixit-Stiglitz aggregator that incorporates the so called “variety” effect, whereby an increase in the number of intermediate goods increases output. Further, this aggregator allows for intermediate goods to be gross complements, as one should think of the services of various network infrastructures, provided by the State (e.g., power, water, phone, roads, railways, harbors, airports, etc.). Thus, by construction, public sector involvement is prima facie beneficial for growth. Nevertheless, and in anticipation of the results of the model, this feature does not prevent public sector expansion being detrimental to growth. In other words, what we propose is a growth model where monopoly rents and incentives for policy distortions are incorporated in a way that their overall effect on growth is ambiguous, as there are also positive effects associated with the provision of publicly provided intermediate good products.

The wage rate of outsiders is determined competitively. Each intermediate good producer prices its output satisfying a zero profit condition, taking the wage rate offered by the corresponding insiders’ union as given. This determines each intermediate good producer’s employment and output. Then, the corresponding wage rate is determined by the respective union that takes the demand for labor it faces, as given. This is the well known Monopoly-Union model of McDonald.

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8 In the insiders-outsiders theory of Lindbeck and Snower (1986), some worker participants (“insiders”) have privileged positions relative to others (“outsiders”). Insiders get market power by resisting competition in a variety of ways, including harassing firms and outsiders that try to hire/be hired, by underbidding the wages of insiders and by influencing pertinent legislation (Saint-Paul (1996)). There has been no association of the wage premium in the public sector and insiders-outsiders labor market, to our knowledge, in the literature. However, the importance of insiders-outsiders labor markets for providing the microeconomic foundations for justifying the strength of unions has been at the core of this literature (see, e.g., the survey by Lindbeck and Snower (2001)). As already mentioned, in the previous footnote, the strength of the unions in the public sector in the South European countries has been noticed in the political science literature.
and Solow (1981) and Oswald (1983). Since there are as many independent unions of insiders as there are intermediate good producers, overall equilibrium in the market for insiders’ labor is characterized by a Nash equilibrium among all insiders’ unions. This modeling choice is, again, consistent with Greek labor market institutions, as well as those of other Southern European countries, where the wage setting process in the public sector is characterized by trade union fragmentation and, at the same time, lack of co-ordination. This is quite different from other typically identified country clusters. For example, in Anglo-Saxon countries wage bargaining is thought, in general, to be competitive and labor unions are thought to play a relatively small role in wage setting. On the other hand, in the Nordic countries, labor unions in all sectors are thought to be powerful but cooperative, thereby internalizing the externalities associated with a high wage premium of one industry/sector on the rest.

In the symmetric equilibrium case, given reasonable parameter restrictions, the ratio of the wage rate of insiders over that of the outsiders (i.e., the public sector wage premium) is greater than one and increasing in the degree intermediate goods are gross complements, as well as in the number of publicly provided intermediate goods. Moreover, the wage premium and the ratio of employment in the public sector over total employment are inversely related, giving rise to the “labor misallocation effect”. For a fixed number of insiders’ unions, this model is formally equivalent to a standard Cass-Koopmans neoclassical growth model, where Total Factor Productivity (TFP) declines with the wage premium, but increases with the number of intermediate goods, as the “variety” effect dominates over the “labor misallocation” effect. However, the overall effects on steady state capital, output and growth towards the steady state, depend on the after-tax labor productivity. For it is assumed that the underlying infrastructure, associated with the publicly provided intermediate goods, is financed by a distortionary income tax. Then, it is shown that the effect of an increase in the number of publicly provided intermediate goods on steady state output and growth towards this steady state is negative (positive), depending on the existing number of publicly provided intermediate goods. If this number is higher or lower than a certain threshold, the combination of the “labor misallocation” and the tax distortion effects dominates over (is dominated by) the “variety” effect. All this being quite plausible, as the “variety” effect decreases, and the “labor misallocation” and tax distortion effects both increase with the existing number of publicly provided intermediate goods, i.e., public sector expansion.

Further, if the number of publicly provided intermediate goods is allowed to vary, each group of insiders union realizes that it has a common interest with all other groups of insiders unions in controlling/influencing the number of publicly provided intermediate goods. Hence, it is to the

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9 See Sections 3.5.2 and 3.9 in European Commission (2013) and European Commission (2014).
10 See Visser (2013).
interest of all insiders’ unions to cooperate so as to control/influence government and its budget. For that matter, we consider a politicoeconomic equilibrium defined as the solution to the problem of a government, seeking to maximize an objective function, that to some degree is influenced by representative household preferences and is likewise influenced by insiders’ unions preferences. This maximization is subject to the underlying economic equilibrium and the government budget constraint. Under plausible restrictions, we prove that such a politicoeconomic equilibrium exists and is characterized by a steady state which is globally asymptotically stable. Moreover, it is shown that such politicoeconomic equilibrium will be characterized by a number of publicly provided intermediate goods that is greater the greater is the influence of insiders. This, in turn, implies that such a politicoeconomic equilibrium will be supported by a higher (distortionary) income tax rate and/or debt level, the greater is the influence of insiders. This is the “political effect” that, depending on the number of publicly provided intermediate goods, may further reduce steady state capital, output, and output growth towards the steady state. It follows, therefore, that, to the degree that the political and economic system of a country is like the insiders-outsiders society of this model, it would exhibit a relatively high wage premium in the public sector, low public to total employment ratio, and lower steady state after-tax total factor productivity, capital, output and growth towards this steady state.

So we have two results: First, a government influenced by insiders will choose a higher number of publicly provided intermediate goods and second, after-tax total factor productivity rises or falls depending on whether this number is lower or higher than a certain threshold. It is the combination of these two results, that leads to the model’s prediction that countries which behave sufficiently close to an insiders–outsiders society: First, will have a lower steady state growth, and second, in what concerns transition towards this steady state, although they may enjoy relatively high growth early on, will eventually suffer from a growth reversal.

Hence, following the potential growth reversal outcome predicted by our model, we view the Greek crisis as a consequence of the insiders-outsiders organization of society. Since debt could be easily introduced in this model, without affecting the qualitative results, our model has also implications for the unsustainable Greek sovereign debt. First, obviously, a growth reversal would increase the debt to GDP ratio by reducing the denominator. Second, the growth reversal itself is driven by the dominance of the labor misallocation and tax distortion effects over the growth.

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11 A taxation-debt channel could be introduced in a number of ways. For example, it can be easily verified that, in a small open economy version of our model, whereby borrowing interest rates are an increasing function of the outstanding debt to GDP ratio, there will be a uniquely determined steady state of this ratio. And, an increase in the number of publicly provided intermediate goods will lead to an increase in this debt ratio, as well as the income tax. The proportion of tax to debt financing will depend on the rate at which interest rates increase with the debt do GDP ratio. We do not pursue this extension here, since this would have come to the cost of sacrificing the analytic results on growth.
enhancing effect of public sector expansion. This dominance is driven by higher taxes needed to
finance the expansion and maintenance of public sector infrastructures that will ensure and provide
for high wages in the public sector. For an economy that lies on the “slippery” side of the Laffer
curve, as Greece seems to be, this would imply an increase in debt. Consequently, an insiders-
outsiders society will further increase the debt to GDP ratio by increasing the numerator.

The results of this paper relate to several different strands of the literature on political
economy, public finance, growth and European integration. First, it relates to the rent seeking /
special interests political economy literature. In particular, it incorporates two basic ideas of that
literature. First, that insiders seek rents from the political system for their own benefit and that the
agents of the political system accommodate these demands in pursuit of their economic and political
goals. Second, that, once the political system allows it, rent seekers are formed in groups, so as to
take advantage of their common interests in rent seeking, by controlling/influencing government.
Also, it shares with the recent political economy and economic growth literature, the idea that
resources devoted to rent seeking may be ultimately detrimental to growth.

Second, it relates to the unifying theory of Acemoglu (2006) who develops a general
framework for analyzing the growth implications of politicoeconomic equilibria. Considering three
groups of agents: workers, “elite” producers and “middle class” producers. Elite producers control
the government and tax middle class producers through a distorting income tax and distribute the
proceeds among themselves via a lump-sum transfer. We share with Acemoglu (2006) both the
strategic interactions in solving for a politicoeconomic equilibrium, as well as the notion of the

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12 Trabandt and Uhlig (2010) and Bi and Traum (2014) find that this is the case for the Greek economy.
13 The idea that the various beneficiaries of government policies are more likely to get politically organized, whereas the
interests of the un-organized general public are neglected is found in the pioneering works of Schattschneider (1935),
2009 Chapters 22, 23).
15 Acemoglu's motives for increasing the distorting tax are three: (a) “Revenue extraction”: the provision of resources
for the benefit of the elite; (b) “Factor price manipulation”: the lowering of factor prices used in the elite’s production
process; and (c) “Political consolidation”: the impoverishment of middle class producers, so as to prevent them from
acquiring the resources necessary to achieve political power. To anticipate the workings of our model, we may think of
insiders as acting according to Acemoglu’s three motives. The first and the third of these motives for increasing the
distorting income tax, are captured by the need for the maintenance of the existing (old) and the creation of the new
publicly provided infrastructure that ensures the funding for their employers businesses. The second motive is captured
by the fact that an increase in the income tax rate, increases the user cost of capital and the wage rate of outsiders,
lowering the demand for these factors and increasing the demand for services of intermediate good products. This, in
turn, increases the demand for insiders’ labor, in such a way so as to increase the wage premium in the public sector.
Like in Acemoglu, it is this effect that seems to be the most damaging for the economy. However, there are important
differences between Acemoglu’s framework and the one developed herein. First, the roles of “elite entrepreneurs” and
“middle class entrepreneurs” are taken, here, by “insiders” and “outsiders”, that they are both workers. Second, since
insiders are organized in unions, that set the wage rate, there is an additional distortion in our model’s economy over
and above the tax distortion. This additional distortion strengthens the “factor price manipulation” effect. Third, there is
a fundamental nonlinearity, as an increase in the distorting tax rate, so as to increase the number of publicly provided
intermediate goods, may be beneficial for the economy, if the number of existing publicly provided intermediate goods
is relatively low and the opposite may be true, if the existing number of those goods is relatively high.
“political elite”. The latter is taken to make the political decisions and engage in economic activities. In our case, the political elite consists of the members of insiders’ unions. However, our structure is richer than Acemoglu (2006), as we allow for a positive effect on TFP, associated with the provision of publicly provided intermediate good products. Thus, government spending, in our model, is not pure waste. On the contrary, it generates a positive effect on TFP and output.

Third, it relates to the literature on models that distinguish between public and private employment, focusing on public-private wage determination. Forni and Giordano (2003) consider a static model of private and public sector wage determination. In their model there are many public and private firms and two unions representing public and private sector employees. They consider a variety of solutions for the game between the two unions and the firms. Our model shares with one of their solution concepts - that of a “fragmented government” - the notion that government consists of a variety of independent firms. There is also a number of dynamic general equilibrium models that examine the behavior of public and private sector wages over the business cycle (e.g., Ardagna (2007), Fernandez de Cordoba, et al. (2012)). Typically in this literature, wages in the public sector are determined as the outcome of a non-cooperative game between the union of public sector employees and a government that cares about total employment. As in this literature, our model has a key role for the public sector wage premium. However, we have chosen to determine this premium following the “cartel sector” model of Cole and Ohanian (2004) whereby labor is divided between groups of insiders and outsiders. And, as already noted, insiders and outsiders work for public (cartel) and private (competitive) sector firms, respectively, while government is influenced by insiders in setting public policies.

Fourth, it relates to the “varieties of capitalism” literature of political science, pioneered by Hall and Soskice (2001), as well as Esping-Andersen’s (1990) “three worlds of welfare capitalism” social model analysis. In this literature, it has been suggested that Greece as well as other Southern European countries have their own “variety” of capitalism, where the state plays a major role (see, e.g., Molina and Rhodes (2007) and Featherstone (2008)). In a sense, the insiders-outsiders society idea is based on the institutional complementarity between market organizations, where the wage premium favors individual groups of society (“insiders”) and the political system, where these groups control or influence government, for insiders’ collective benefit. As already noted, this interaction has been emphasized on another strand of the political science literature, namely, that on “neo-corporatism” (Schmitter (1977), Sargent (1985), Cawson (1986)).

Finally, our results should be of interest to the European integration question. Countries that have gone beyond a certain point toward the insiders-outsiders society, as Greece and possibly other Southern European countries might have, will experience difficulties following the others in after-
tax TFP growth.\textsuperscript{16} This outcome has already been suggested by several policy influential economists (see, e.g., Blanchard (2004), Alesina and Giavazzi (2004)).

The rest of the paper is organized as follows: Section 2 develops the model. Section 3 establishes the main results of the paper. Section 4 discusses the model’s explanation of the growth reversal and the stylized facts mentioned above and Section 5 concludes.

2. THE MODEL

Time is discrete and there is no uncertainty. The economy consists of a large number of identical households whose members supply labor and capital services and consume a final good. This final good can either be consumed or invested and is produced by means of physical capital and labor services, as well as, the services of a number of intermediate goods provided by government. Household labor consists of two kinds: Labor supplied to the final good producers in a competitive market and labor supplied to the publicly provided intermediate goods through independent monopolistic labor unions. Moreover, these monopolistic unions cooperate in controlling/influencing all government policies. Household members supplying their labor competitively will be referred to as “outsiders” and household members supplying their labor through labor unions will be referred to as “insiders.” And, the model economy will be referred to as the “insiders-outsiders society.”

2.1. Households and Firms

Household preferences are characterized by a standard time separable lifetime utility function of the form $U^h = \sum_{t=0}^{\infty} \beta^t \frac{c^{1-\gamma} - 1}{1-\gamma}$ where: $\beta \in (0,1)$ is the household discount factor, $c_t$ is consumption per capita in period $t$, and $1/\gamma \in (0,\infty)$ is the constant elasticity of intertemporal substitution. Households own physical capital, that depreciates according to a fixed geometric depreciation rate, $\delta \in (0,1]$ and evolves according to $k_{t+1} = (1-\delta)k_t + i_t$, where $k_t$ is capital stock at the beginning of period $t$ and $i_t$ is gross investment in period $t$. In every period $t$, each household has available a fixed amount of labor time, $\bar{h} \in (0,\infty)$, that can be allocated to the production of the final good, $h^*_t$, and the production of services from a continuum of intermediate goods, $[0,N_t]$, provided by government. Thus, the time constraint of each household, in every period $t$, is given by:

\textsuperscript{16} For Greece, this has been argued in Kollintzas, et al. (2012). Kollintzas, et al. 2015, present evidence for the presence of insider-outsider society characteristics in other Southern European countries, as well.
where: $h_t^i(z)$ is labor time devoted by each household to the production of services from the $z$ intermediate good, in period $t$.

Although our formulation of households allocating time among final and intermediate good sectors is admittedly a highly schematic one, as already mentioned, the reader may think of households having many members, where some are “insiders” and others are “outsiders.” As will be made apparent below, the numbers of insiders and outsiders in our model are determined by the demand side (firms and unions), exclusively. Allowing insiders’ layoffs, as in Cole and Ohanian (2004), could determine the numbers of insiders and outsiders by the supply side (households), as well. For tractability purposes, we have chosen not to pursue this extension here. At any rate, in our model, as well as in Cole and Ohanian (2004), there is perfect household insurance among household members, whether insiders or outsiders. Hence, the profoundly important income distribution effects of the insiders–outsiders society are, consequently, ignored. And, as is, of course, the important question of who chooses to become an insider and who ends up as an outsider, in the presence of these income distribution effects.

The budget constraint facing each household, in any given period $t$, is given by:

$$c_t + k_{t+1} - (1 - \delta)k_t = (1 - \tau_t) \left[ r_t k_t + w_t^o h_t^c + \int_0^{N_t} w_t^i(z) h_t^i(z) dz \right]$$

where: $\tau_t$ is the income tax rate in period $t$, $r_t$ is the rental rate of capital services in period $t$, $w_t^o$ is the wage rate for labor time devoted to the production of the final good, $w_t^i(z)$ is the wage rate for labor time devoted to the production of services from the $z$ intermediate good, in period $t$.

The representative household seeks a consumption, capital accumulation and time allocation plan so as to maximize lifetime utility, subject to the time and budget constraints, (1) and (2), respectively. In so doing, the representative household takes all prices, income tax rates, and numbers of intermediate goods, as given.\(^\dagger\)

In view of the functional form of the temporal utility function, specified above, necessary and sufficient conditions for a solution to the problem of the representative household are the standard side conditions along with the Euler condition:

\(^\dagger\) Obviously, if $w_t^i(z)$ is different from $w_t^o$, the household will not be indifferent between $h_t^o$ and $h_t^i(z)$. If, for example, $w_t^i(z')$, for some $z'$, is greater than $w_t^o$, the household would prefer $h_t^i(z')$ over $h_t^o$. Likewise, if $w_t^i(z')$ is greater than $w_t^i(z''')$, for any given $z''$, the household would prefer $h_t^i(z')$ over $h_t^i(z''')$. In any case, in the solution to the household’s problem, (1) will hold with equality. Later, $h_t^o$ and $\{h_t^i(z)\}_{z \in [0,N_t]}$ will be set following demand conditions and institutional constraints, without violating household incentives.
Production in the final good sector takes place in a large number of identical firms. The production technology of the representative firm in this sector is:

\[ Y_t = K_t^a (A_t L_0^0)^b \left[ \int_0^{N_t} x_t(z)^{\zeta} dz \right]^{a-b} ; \quad a, b > 0, \; a + b < 1 \; \& \; \zeta \in (0, 1] \]  

where: \( Y_t \) is output supplied in period \( t \), \( K_t \) is physical capital services used in period \( t \), \( A_t \) is labor services used in period \( t \), \( L_0^0 \) is a parameter that designates the level of (Harrod–neutral) technology at the beginning of period \( t \) and grows according to: \( A_{t+1} = (1 + g_A) A_t \), \( g_A \in [0, \infty) \); and \( x_t(z) \) is the services from the \( z \) intermediate good used in period \( t \). The RHS of (4) is a constant returns to scale production function. The Dixit-Stiglitz aggregator is used to model the composite of all intermediate good inputs, \( \left[ \int_0^{N_t} x_t(z)^{\zeta} dz \right]^{(1/\zeta)} \), in a tractable manner. Thus, we assume that there is a continuum of intermediate good products and that \( N_t \) is a positive real number. Restricting \( \zeta \in (0, 1] \) ensures that output increases with the number of intermediate goods, so as to capture the so called “variety” effect, introduced by Romer (1990).\(^{18}\)

Although we think of intermediate goods as goods provided by government, we do not think of these goods as pure public goods. In particular, we think of intermediate goods as being excludable, in the sense that only those final good producers that pay for using the services from a given intermediate good can use those services. Moreover, these goods are not necessarily non-rival, in the sense that a final good producer that uses the services from a given intermediate good may or may not limit the amount of services used by other final good producers. Actually, most publicly provided services are excludable and to a great extend rival. For example, in many countries basic utilities (electrical power, water and sewage, garbage and waste collection and disposal, stationary telephony and natural gas), transportation networks (railroads, harbors, airports), and various licenses (foods and drugs, fire and flood safety) are provided to their users for a price.

Cole and Ohanian (2004), in their seminal paper, where they examine the effects of New Deal policies on the recovery from the Great Depression in the United States, consider two kinds of intermediate goods sectors. In their model, labor is supplied to two sectors: the noncompetitive

\(^{18}\) A discussion on the properties of the Dixit-Stiglitz aggregator, as well as discussions on the properties of the solution to the problem of the \( z \) union of insiders (see section 2.2) and the government budget constraint as the law of transition for public capital (see section 2.3) that follow, can be found in sections 1, 2 and 3, of the Complementary Technical Appendix.
“cartel” sector and the “competitive” sector, much like in our formulation, but in their model government policies are exogenous. Further, the number of intermediate good products (varieties) in their formulation, is taken to be fixed and only the distribution of those products between the two sectors is endogenously determined. We have opted to consider publicly provided intermediate goods only, for as already said, we are motivated by Greek macroeconomic and political structures, where the state plays a major role and the number (varieties) of publicly provided intermediate goods products may have been an important contributor to growth. And, obviously, the way the variety effect is modeled, here, gives an incentive for expanding the public sector via the increase of the number of publicly provided intermediate goods, \( N_j \).

Let \( p_j(z) \) be the price for the services of the \( z \) intermediate good in period \( t \). At the beginning of any given period \( t \), the representative final good producer, maximizes profits:

\[
\pi_t^* = K^u(A_tL_t^0)^b \left[ \int_0^N x_t(z) \zeta dz \right]^{1-a-b} - \tau_t K_t - w_t^0 L_t^0 - \int_0^N p_t(z)x_t(z)dz ,
\]

(5)

taking all input prices and the number of intermediate good producers as given.

The (inverse) demand for the services from the \( z \) intermediate good is:

\[
(1-a-b)K^u(A_tL_t^0)^b \left[ \int_0^N x_t(z')\zeta' dz' \right]^{1-a-b-\zeta} x_t(z')^{\zeta-1} = p_t(z); \ \forall z \in [0,N_j].
\]

(6)

Demand increases (decreases) with the composite of all intermediate good inputs, \( \left[ \int_0^N x_t(z')\zeta' dz' \right]^{1/\zeta} \) or, for that matter, with any given intermediate good \( z' \in [0,N_j] \), if and only if \( \zeta < 1-a-b \) (\( \zeta > 1-a-b \)). That is, if and only if intermediate goods are gross complements (gross substitutes). Clearly, however, gross complementarity is more compatible with the idea of public intermediate goods being basic utilities, transportation networks, licenses, etc. Therefore, throughout, we shall maintain the assumption that intermediate goods are gross complements:

**Assumption 1:** \( 1-a-b-\zeta > 0 \)

As the infrastructure associated with each intermediate good is provided by government, the services of intermediate goods are produced by using labor only:

\[
X_t(z) = \Phi(z) A_tL_t^0(z); \ \Phi(z) \in (0, \infty), \ \forall z \in [0,N_j] & t \in \mathbb{Z}.
\]

(7)

---

19 A generalization of the model that includes privately provided intermediate goods, as well, is straightforward, along the lines of Cole and Ohanian (2004). Such an extension would make the model much richer and allow us to address additional questions such as the effects of complementarity or substitutability in production among the private and the public sectors, as well as new aspects stemming from the strategic interaction of private and public sector unions (see also the discussion in the end of section 4). This, however, also comes at a cost of increasing considerably the model’s complexity and, consequently, preventing analytical results.
where: $X_t(z)$ is output supplied in period $t$ and $L_t(z)$ is labor services used in period $t$.

In any given period $t$, the representative producer of services from the $z$ intermediate good chooses labor input, so as to achieve zero profits: \[ \pi_t(z) = p_t(z) X_t(z) - w_t(z) L_t(z) = 0, \] taking the production technology constraint (7), the demand for its services (6), the number of intermediate good producers, the labor input choices of all other intermediate good producers and wages as given. This gives the following (inverse) aggregate demand for labor in the production of services from the $z$ intermediate good:

\[
(1 - a - b) A^{1-a} K^a L_t^b \left\{ \int_0^N \Phi(z') L_t(z') \frac{dz'}{z} \right\}^{\frac{1-a-b-z}{\alpha}} = w_t(z) \]  \hspace{1cm} (9)

Clearly, given Assumption 1, this demand increases with the weighted average of the labor input in the production of services of all intermediate goods, \[ \left\{ \int_0^N \Phi(z') L_t(z') \frac{dz'}{z} \right\}^{\frac{1}{\alpha}}. \] This formulation is consistent with Greek experience, where public utilities, transportation networks, and other publicly provided services are supplied by a single agency/firm that has a monopoly, but is heavily regulated. However, these agencies/firms end up behaving like unregulated monopolist, due to the behavior of the union that controls their labor input.\(^{22}\) And this is the model feature we turn next.

### 2.2 Insiders’ Unions

Labor used in the production of services from each intermediate good $z$ is organized in a union. That is, there is a separate union $z$ for each intermediate good $z$, for all $z$. We refer to these unions as “insiders’ unions.” Following the standard union literature, we assume that the preferences of the $z$ union of insiders are characterized by the utility function

\[ U^i(z) = \sum_{t=0}^{\infty} \beta^t \ln \left[ w_t(z) - w_t^0 \right] L_t(z), \]  where $\lambda(z) \in (0,1), \forall z \in [0,N]$, and $t \in \mathbb{Z}^+$. This form of union preferences corresponds to the “utilitarian” model of McDonald and Solow (1981) and Oswald (1982), where the representative union member has a constant relative rate of risk aversion.

\(^{20}\) This is not a crucial assumption and the propositions of this paper would go through with publicly provided intermediate good service producers having some other objective, like regulated profits. For simplicity purposes, this is not pursued in this paper.

\(^{21}\) The number of final good producers is irrelevant, in this model, due to the CRS production function in (4) and perfect competition. Moreover, the number of $z$ intermediate good service producers is also irrelevant due to the CRS production function in (7) and the zero profit restriction. Thus, without loss of generality, (9) has been expressed in representative final good producers units.

\(^{22}\) A classic example is the Greek Power Company (ΔΕΗ), which although a de facto monopoly, has more or less zero profits, but its labor union (ΤΕΝΟΠ-ΔΕΗ) has substantial market and political power, that results in substantial wage premiums and other benefits for its members (See, e.g., Michas (2011), for a narrative).
provided that union membership is fixed. Here, union membership is determined by the union and is fixed and equal to employment in the production of services of the corresponding intermediate good sector. Further, \( w^0 \) is the “alternative wage” for insiders, in the sense that, \( w'(z) - w^0 \) is the wage premium of insiders over outsiders and at the same time the wage premium in the public sector. The latter, as already noted, are all those that work in the final good sector of the economy. And, finally, \( \lambda(z) \) is a parameter that measures the relative preference of the wage premium over employment for the \( z \) union of insiders. As usual, we take \( \lambda(z) \) to stand for a measure of the union’s relative bargaining power.

At the beginning of any given period \( t \), the \( z \) union of insiders seeks a wage and employment plan so as to maximize its utility, subject to the aggregate demand for labor in the production of services from the \( z \) intermediate good (9); and, the institutional constraint: \( L'(z) > 0 \), if and only if \( w'(z) > w^o \); \( \forall z \in [0, N_z] \) & \( \forall t \in \mathbb{N}_+ \). In so doing, the \( z \) union of insiders takes the aggregate capital, the aggregate employment of outsiders, the wage and employment choices of all other unions of insiders and the number of intermediate good producers, as given.

Let \( \eta_t(z) = -\frac{\partial L'(z)}{\partial w'(z)} \frac{w'(z)}{L'(z)} \) be the elasticity of the demand for labor facing the \( z \) union of insiders. Then, provided that \( \eta_t(z) > \lambda(z) \), as we shall ensure below, there exists a unique solution to the problem of the \( z \) union of insiders, which is interior (i.e., \( w'(z) > w^o \), \( L'(z) > 0 \) and such that there is a wage premium given by:

\[
\nu_t(z) = \frac{w'(z)}{w^o} = \frac{1}{1 - \frac{\lambda(z)}{\eta_t(z)}}
\]

(10)

This is the well known tangency condition of the union indifference curve and the demand for labor facing that union. In this solution \( L'(z) \) is less than the employment level that corresponds to a situation where \( w'(z) = w^o \). Although all union members are employed, the union restricts employment, and hence union membership, in order to raise the wage rate enjoyed by its members. This, of course, implies an important “misallocation” effect of the insiders-outsiders society. This friction has profound implications for both output and growth. It will be more convenient, however, to examine the important implications of this effect, as well as, the restrictions imposed upon the model’s parameters by the condition \( \eta_t(z) > \lambda(z) \), after the model’s structure has been completed.

Again, however, this is consistent with Greek experience, where the workers of publicly provided intermediate goods are organized in powerful and independent labor unions, while the corresponding intermediate good producers are heavily regulated.
2.3 Government Budget

The government’s budget constraint, expressed in representative household units, in any given period $t$, is given by:

$$
\int_{0}^{N_t} \hat{\Psi}_t(z)dz + \int_{0}^{N_t} \hat{\Psi}'_t(z)dz = \tau \left[ r_t k_t + w_t^0 h_t^0 + \int_{0}^{N_t} w'_t(z)h'_t(z)dz \right]
$$

(11)

where $\hat{\Psi}_t(z)$ is the cost of setting up (dismantling) new (old) $z$ intermediate good infrastructure in period $t$ and $\hat{\Psi}'_t(z)$ is the cost of administering and maintaining the existing $z$ intermediate good infrastructure in period $t$. That is, the first term in the LHS of (11) should be thought of as the investment cost of new infrastructure and the second term in the LHS of (11) as the cost of maintaining the existing infrastructure. $\hat{\Psi}_t(z)$ and $\hat{\Psi}'_t(z)$ will be further specified, shortly.

2.4 Symmetric Equilibrium

For tractability purposes, in what follows we shall characterize the equilibrium in the symmetric case, where there are no differences across intermediate good service producers, the corresponding insiders’ unions, and the distributions of $\Phi(z), \hat{\Psi}_t(z)$ and $\hat{\Psi}'_t(z)$ are uniform.

More specifically, we assume: $\Phi(z) = \Phi; \Phi > 0, \lambda(z) = \lambda; \lambda \in (0,1), \hat{\Psi}_t(z) = \hat{\psi} y_t$; $\hat{\Psi}'_t(z) = \hat{\psi}' y_t; \hat{\psi} > \hat{\psi}' > 0; \forall z \in [0, N_t] \& t \in \mathbb{Z}_+$. The last two restrictions make investment in new infrastructure and maintenance of existing infrastructure, fixed functions of output per efficient household. Obviously, these are strong restrictions for analyzing business cycle effects. But, herebelow, they are not so restrictive, as we limit our attention in steady states and convergence towards these steady states. Also, the restriction $\hat{\psi} > \hat{\psi}'$ incorporates the notion that it is more expensive to develop than to maintain one unit of public sector infrastructure.

Then, the equilibrium of this economy, where all agents solve their respective problems and all markets clear, is characterized by the following set of equations:

$$
h_t^0 = \frac{b v(N_t)}{b v(N_t) + (1 - a - b)} h
$$

(12)

$$
N_t h_t' = \frac{(1 - \alpha - b)}{b v(N_t) + (1 - \alpha - b)} h
$$

(13)

$$
y_t = \xi(N_t) k_t^a
$$

(14)

---

23 To simplify notation $c_t, k_t, y_t$ in (14)-(16) and henceforth, are equal to the previously defined $c_t, k_t, y_t$ divided by $\lambda h$.\"
\[
\frac{c_{i+1}}{c_i} = \left[ \beta (1 + g_A)^{-1} \left\{ (1 - \delta) + \alpha \left[ 1 - \psi (N_{i+2} - N_{i+1}) - \psi N_{i+1} \right] \xi (N_{i+1}) k_{i+1}^{a-1} \right\} \right]^{1/\gamma}
\]
(15)

\[
\frac{k_{i+1}}{k_i} = (1 + g_A)^{-1} \left\{ (1 - \delta) + [1 - \psi (N_{i+1} - N_i) - \psi N_i] \xi (N_i) k_i^{a-1} - c_i k_i^{a-1} \right\}
\]
(16)

where

\[
\nu(N_i) = \frac{w_i^i}{w_i^b} = \frac{N_i}{[1 - \lambda (1 - \zeta)]N_i + \lambda (1 - \alpha - b - \zeta)}
\]
(17)

and

\[
\xi(N_i) \equiv b^b (1 - a - b)^{(1-a-b)(1-\zeta)} \Phi^{(1-a-b)(1-\zeta)} N_i^{\frac{(1-a-b)(1-\zeta)}{\zeta}} \nu(N_i)^b \frac{\nu(N_i)^b}{[1 - a - b + b \nu(N_i)]^{1-a}}
\]
(18)

Equations (12) and (13) give the allocation of total household time between final good and intermediate public good production and for that matter between insiders and outsiders, respectively. Equation (14) gives output in the neoclassical growth model format, so that \( \xi(N_i) \), defined in Equation (18), is total factor productivity, in period \( t \). Equations (15) and (16) are the laws of motion of consumption and capital. The former incorporates the government’s budget constraint and the latter incorporates the resource constraint of the economy. Equation (17) specifies the public sector wage premium, \( \nu(N_i) \), which is tantamount to the wage premium of insiders over outsiders. Clearly, the wage premium affects the economy’s resource allocation through total factor productivity. The number of publicly provided intermediate goods, \( N_i \), affects total factor productivity both directly and indirectly through the wage premium. The former is associated to the variety effect and the latter to the misallocation effect, discussed in the Introduction. Hence, the number of publicly provided intermediate goods affects the economy’s resource allocation, via after-tax total factor productivity, \( [1 - \psi (N_{i+1} - N_i) - \psi N_i] \xi (N_i) \), threefold: First, through the wage premium, second through the variety effect, and third through taxation. The latter is associated with what we shall refer to as the “political effect.”

2.4.1 The Insiders’ Wage Premium

To ensure that the wage premium of insiders over outsiders is greater than one, we need the following parameter restriction:

**Assumption 2:**

\[
(1 - \zeta) - \frac{1 - \alpha - b - \zeta}{N_i} > 0
\]
This simply implies that the demand for insiders’ labor is downward sloping and puts a lower bound on $N_t$. That is, $N_t \geq \frac{1-\alpha-b-\zeta}{1-\zeta}$. Also, given $\lambda > (0,1)$, Assumptions 1 and 2 ensure that $0 < \lambda / \eta = \lambda \left[ (1-\zeta) - \frac{1-\alpha-b-\zeta}{N_t} \right] < 1$, and it follows from (17) that the wage premium is greater than one. Moreover, in view of Assumption 1: $\nu'(N_t) = \frac{\lambda(1-a-b-\zeta)[\nu(N_t)]^2}{N_t^2} > 0$ and $\nu''(N_t) = \frac{-2\lambda(1-a-b-\zeta)[1-\lambda(1-\zeta)][\nu(N_t)]^3}{N_t^3} < 0$. Observe, then, that a necessary and sufficient condition for $\nu'(N_t)$ to be positive (negative) is that intermediate goods are gross complements (substitutes). Hence, Assumption 1 (gross complementarity) ensures that the wage premium increases with the number of intermediate goods. Summarizing results, we have shown the following:

**Proposition 1 (Properties of Insiders’ Wage Premium):** Given Assumptions 1 and 2, $\nu(N_t):\left(\frac{1-\alpha-b-\zeta}{1-\zeta}, +\infty\right) \rightarrow \left(1, \frac{1}{1-\lambda(1-\zeta)}\right)$ is strictly increasing and strictly concave in $N_t$ and approaches asymptotically $\frac{1}{1-\lambda(1-\zeta)}$. Also, $\nu(N_t)$ is greater: (i) the greater the relative bargaining power of unions, $\lambda$; (ii) the lower the elasticity of labor demand facing intermediate good service producers, $\eta = \left[1-\zeta - \frac{1-\alpha-b-\zeta}{N_t}\right]^{-1}$; and (iii) the greater the degree intermediate goods are gross complements, $1-\alpha-b-\zeta$.

The economic rationale behind the results of Proposition 1 is straightforward. The wage premium is a consequence of the organization of the labor market. And, in particular, of the market power enjoyed by insiders’ unions. Suppose, that labor input in the production of services of intermediate goods is supplied competitively. Then, since labor services are identical, equilibrium in the labor market implies that $h_i^r$ and $N_i h_i^r$ are set so that the marginal products of labor in the final good sector and the services of the intermediate goods sector are equal to the common (real) wage rate. And, there is no wage premium (i.e., $\nu(N_t) = 1$). Alternatively, the latter will hold in this model, under two possibilities. First, when $\lambda = 0$, that is when the union does not care about the
wage premium. And second, when $\eta = +\infty$, that is when the union faces an horizontal demand for labor.

In view of (12) and (13), an immediate implication of Proposition 1 is the following:

**Corollary 1:** Given Assumptions 1 and 2, the ratio of employment in the publicly provided intermediate goods sector (i.e., public employment, $N_i h_i^t$) over total employment, and employment in the final good sector (i.e., private employment, $h_o^t$) over total employment decrease and increase, respectively, with the public sector wage premium and reach their maximum and minimum values, respectively when there is no wage premium.

When $v(N_i) > 1$, the monopolistic unions restrict labor input, so as to receive a higher wage rate. This result relates to what we refer to as the “labor misallocation” effect, to whose implications we turn next.\(^{24}\)

### 2.4.2 Total Factor Productivity

Given Proposition 1, total factor productivity, $\xi(N_i)$, is positive. As already mentioned, $N_i$ affects $\xi(N_i)$ both directly, through the middle term in the RHS of (18) and, indirectly, through the relative wage premium, $v(N_i)$. The direct effect of $N_i$ on $\xi(N_i)$ is positive and relates to the production technology assumed. That is, as long as intermediate goods are not perfect substitutes (i.e., $0 < \zeta < 1$), an increase in the number of intermediate goods, increases TFP and output. For, each intermediate good input is subject to diminishing returns to scale and, therefore, for any given amount of the aggregate input, $N_i x_i$, more output is produced if there are more intermediate goods, $N_i$, composing this aggregate input. This is what is referred to as the “love-for-variety” effect or simply “variety” effect in the growth literature. The indirect effect relates to the wage premium being greater one, for if the wage premium is one, the last term in the RHS of (18) becomes unity. This effect is negative. To check this, we look at the change in $\xi(N_i)$ brought about by a change in the relative wage premium that does not emanate from a change in $N_i$ (i.e., $\frac{\partial \xi}{\partial v_{N_i, fixed}}$) and the change in $\xi(N_i)$ brought about by a change in $N_i$ (i.e., $\xi'(N_i)$). It follows from (18) that

---

\(^{24}\) Much like the standard insiders-outsiders labor market theory suggests, this model can easily account for outsiders’ unemployment, by introducing a minimum wage rate which is greater than $w_0^i$ and increases the reservation wage of insiders. In fact, the higher the wage premium in the public sector, the stronger the “misallocation” effect and the lower the demand for outsiders labor, implying greater unemployment amongst outsiders, for any given minimum wage rate.
\[
\frac{\partial \xi}{\partial v} \bigg|_{N_{i, fixed}} = 0 \quad \text{as} \quad 1 + \frac{b}{1-a} (\nu - 1) = \nu. \quad \text{Given Assumptions 1 and 2, } \nu > 1. \quad \text{But, for } \nu > 1,
\]
\[1 + \frac{b}{1-a} (\nu - 1) < \nu. \quad \text{Therefore, given Assumptions 1 and 2, } \frac{\partial \xi}{\partial v} \bigg|_{N_{i, fixed}} < 0. \quad \text{The latter defines the}
\]
“labor misallocation effect.” Hence, the overall effect on \( \xi(N_i) \) of a change in \( N_i \) is not obvious.

Herebelow, we summarize results and we show that the overall effect on \( \xi(N_i) \) of a change in \( N_i \) is positive.

**Proposition 2 (Properties of Total Factor Productivity):** Given Assumptions 1 and 2,

\[
\xi(N_i) : \left(\frac{1 - a - b - \epsilon}{1 - \epsilon}, \infty \right) \rightarrow \left(\frac{b^b (1 - a - b) (1 - \epsilon)}{(1 - a)^{(1-a)}} \left[1 - a - b - \epsilon \right]^{(1-a-b)(1-\epsilon)} \right), \quad \text{such that: (a)}
\]
\[\frac{\partial \xi}{\partial v} \bigg|_{N_{i, fixed}} < 0, \quad \text{and (b) } \xi'(N_i) > 0, \quad \forall N_i \in (0, \infty).
\]

**Proof:** In the Appendix.

That is, given gross complementarity (i.e., Assumption 1) and unions facing downward sloping labor demand (i.e., Assumption 2), the “variety” effect dominates over the “labor misallocation” effect. To further illustrate the implications of this “labor misallocation” effect, associated with the equilibrium considered in the previous subsections, it is instructive to consider the Second Best associated with this equilibrium. In this model, there are two reasons that the equilibrium is not Pareto Optimum: Proportional income taxes and the market power of insiders’ unions. Thus, we shall focus our attention to characterizing efficiency losses with respect to a “Second Best” outcome. That is, a situation where there is distorting taxation, but there is no insiders-outsiders organization of society. In this case, of course, there are no insiders’ unions and there is no relative wage premium, nor a “labor misallocation” effect. Formally, we define as a “Second Best” outcome for this economy an equilibrium, where the relative wage premium \( \nu^{SB}(N_i) = 1 \), for all \( t \in \mathbb{R}^+ \). The Second Best is also characterized by (12) – (17), with TFP given by:

\[
\xi^{SB}(N_i) = \frac{b^b (1 - a - b)(1-a-b)}{(1-a)^{(1-a)}} \Phi (1-a-b) \Phi^{(1-a-b)} \left[\frac{1 - a - b - \epsilon}{1 - \epsilon}\right]^{(1-a-b)(1-\epsilon)} N_i .
\]

Consider now the TFP difference function:

\[
\pi(N_i) \equiv \xi^{SB}(N_i) - \xi(N_i) = \frac{b^b (1 - a - b)(1-a-b)}{(1-a)^{(1-a)}} \Phi (1-a-b) \Phi^{(1-a-b)} \left[\frac{1 - a - b - \epsilon}{1 - \epsilon}\right]^{(1-a-b)(1-\epsilon)} \left[1 - \frac{(1-a)^{(1-a)} \nu(N_i)^b}{1 - a - b + b \nu(N_i)^b}\right].
\]

We may think of \( \pi(N_i) \) as the TFP gap due to the “labor misallocation” effect. Clearly, this TFP gap is proportional to the corresponding output gap, \( y_i^{SB} - y_i = \pi(N_i) k_i^a \). This is a measure of the equilibrium efficiency losses relative to the Second Best, where there is no insiders-outsiders...
organization of society. First, we characterize the sign of $\pi(N_i)$ and second, the change of $\pi(N_i)$.

As in the case of $\xi(N_i)$, it is useful to distinguish between two effects: The change in $\pi(N_i)$ brought about by a change in the relative wage premium that does not emanate from a change in $N_i$ (i.e., $\frac{\partial \pi}{\partial \nu|_{N_i \text{ fixed}}}$) and the change in $\pi(N_i)$ brought about by a change in $N_i$ (i.e., $\pi'(N_i)$). Then it is a straightforward application of the results in Propositions 1 and 2 that:

**Corollary 2 (Second Best):** Given Assumptions 1 and 2, $\pi(N_i):(0,\infty) \rightarrow (0,\infty)$, $\frac{\partial \pi}{\partial \nu|_{N_i \text{ fixed}}} > 0$, and $\pi'(N_i) > 0$, $\forall N_i \in (0,\infty)$.

**Proof:** In the Appendix.

As a consequence of the labor misallocation effect, the TFP gap increases with both the public sector wage premium and the number of publicly provided intermediate goods.

### 2.4.3 Growth with a Fixed Number of Publicly Provided Intermediate Goods

Next, we turn to the question of how the number of publicly provided intermediate goods affects capital, output and growth. There are two ways to look into the answer to this question: with a fixed and a variable number of publicly provided intermediate goods. It is instructive to start the analysis with a fixed (given) number of publicly provided intermediate goods. In the case where $N_i$ is fixed, say, $N_i = \bar{N}$, such that $\psi \bar{N} \in (0,1)$, $\forall t \in N_+$, the transitional dynamics of the equilibrium are now characterized by:

$$
\frac{c_{t+1}}{c_t} = \left\{ \beta (1 + g_o)^{-1} \left[ (1-\delta) + \alpha (1 - \psi \bar{N}) \xi (\bar{N}) k_t^{\alpha-1} \right] \right\}^{1\gamma} 
$$

$$
\frac{k_{t+1}}{k_t} = (1 + g_o)^{-1} \left[ (1-\delta) + (1 - \psi \bar{N}) \xi (\bar{N}) k_t^{\alpha-1} - c_t k_t^{-1} \right] 
$$

Thus, any equilibrium steady state, say $(k^*, c^*) \in (0,\infty) \times (0,\infty)$ must satisfy the conditions $\frac{k_{t+1}}{k_t} = \frac{c_{t+1}}{c_t} = 1$, $\forall t \in N_+$. It follows from the above two equations that the locus $\frac{c_{t+1}}{c_t} = 1$ is given by the vertical line in Figure 4. And, the locus $\frac{k_{t+1}}{k_t} = 1$ is given by the inverse U-shaped curve in Figure 4. The intersection of these two lines (point A) defines the equilibrium steady state.
\[
(k^*, c^*) = \left[ \frac{\alpha(1-\hat{\psi}\bar{N})\xi(\bar{N})}{\beta^{-1}(1+g_a)-(1-\delta)} \right]^{\frac{1}{1-\alpha}} (1-\hat{\psi}\bar{N})\xi(\bar{N})k^{\alpha} - (g_a + \delta)k^* \right].
\]

Also, it follows by the above two equations that the transitional dynamics around this steady state are as indicated by the directions of the arrows in Figure 4. Following standard arguments, it can be shown that there exists a unique stable local trajectory to the steady state, to which the economy converges, monotonically. Given any initial value of \(k_0\), consumption “jumps” to the value that corresponds to this stable local trajectory. Clearly, \((k^*, c^*)\) differs from the steady state of the Second Best (point B, say \((k^{SB}, c^{SB})\)), which lies to the north east of point A, by virtue of Corollary 2. And, for any given initial value of \(k_0\), transitional dynamics (monotone convergence) will imply higher growth rates towards the steady state of the Second Best, versus that of point A.

**Figure 4: Steady state and transitional dynamics with fixed number of publicly provided intermediate goods, \(\bar{N}\)**

Now, we are interested in the steady state and the transitional dynamics for different values of \(\bar{N}\). Consider first an increase in the relative wage premium \(\nu(.)\) that does not come from a change in \(\bar{N}\). Clearly, in this case, following Proposition 2, \(\xi(\bar{N})\) will decrease. The \(\frac{k_{t+1}}{k_t} = 1\) locus will drop and the \(\frac{c_{t+1}}{c_t} = 1\) locus will move left. The new steady state (illustrated by point C, in Figure 4)
will lie to the south west of \((k', c')\). And, convergence to this steady state will imply slower growth. Finally, if \(\bar{N}\) increases, both loci will move in the direction \((1-\psi\bar{N})\xi(\bar{N})\) moves. Where the new steady state is going to be, is now ambiguous and depends on the way \((1-\psi\bar{N})\xi(\bar{N})\) changes with \(\bar{N}\). As the following proposition makes clear, for \(\bar{N}\) sufficiently high, \((1-\psi\bar{N})\xi(\bar{N})\) will decrease with \(\bar{N}\). But, for \(\bar{N}\) sufficiently low the opposite might be true.

**Proposition 3** (Variety and Labor Misallocation Effects vs Tax Distortion Effect): Given Assumptions 1 and 2, \(\frac{d(1-\psi\bar{N})\xi(\bar{N})}{d\bar{N}} < 0\) for all \(\bar{N} \in \left(\frac{1-\alpha-b-\zeta}{1-\zeta}, \frac{1}{\psi}\right)\), such that:

\[
\bar{N} > \frac{(1-a-b)(1-\zeta)}{\psi[(1-a-b)(1-\zeta) + \zeta]}. 
\]

And if, \(\frac{1-\alpha-b-\zeta}{1-\zeta} < \frac{(1-a-b)(1-\zeta)}{\psi[(1-a-b)(1-\zeta) + \zeta]}\), there exists a sub-interval \(\left(\frac{1-\alpha-b-\zeta}{1-\zeta}, \bar{N}\right)\) of \(\left(\frac{1-\alpha-b-\zeta}{1-\zeta}, \frac{(1-a-b)(1-\zeta)}{\psi[(1-a-b)(1-\zeta) + \zeta]}\right)\) such that \(\frac{d(1-\psi\bar{N})\xi(\bar{N})}{d\bar{N}} > 0\), for all \(\bar{N}\) in this sub-interval.

**Proof:** In the Appendix.

Since, \(\psi\) should be a relatively small number, the condition \(\frac{1-\alpha-b-\zeta}{1-\zeta} < \frac{(1-a-b)(1-\zeta)}{\psi[(1-a-b)(1-\zeta) + \zeta]}\), puts an upper bound on \(\psi\), that seems reasonable for all practical purposes. For that matter, we shall refer to \(\frac{(1-a-b)(1-\zeta)}{\psi[(1-a-b)(1-\zeta) + \zeta]}\) as the threshold value of \(N\).

Proposition 3 can be illustrated in Figure 4, also. In this case, an increase in \(\bar{N}\) that decreases (increases) \((1-\psi\bar{N})\xi(\bar{N})\) corresponds to a movement northeast (southwest) of point A, like point C (B). Hence, in the case of a fixed number of publicly provided intermediate goods, an increase in the number of these goods will have ambiguous effects on steady state output and growth towards this steady state, as these effects will depend on the existing number of publicly provided intermediate goods. However, the rationale for this nonlinearity is straightforward. For a relatively low \(N\), an increase in this number is associated with the dominance of the “variety” effect over the combination of the “labor misallocation” and “tax distortion” effects. On the contrary, for a relatively high \(N\), an increase in this number is associated with the dominance of the combination of the “labor misallocation” and “tax distortion” effects over the “variety” effect. For, as it can be easily verified, the “variety” effect (“labor misallocation” and “tax distortion” effects) is decreasing
are increasing) with \( N \). The important implication of this result for the stylized facts of the Introduction, will be discussed in the next section.

2.5 Government’s Objective Function

The stage has, now, been set to investigate the case of an endogenous income tax rate or an endogenous number of publicly provided intermediate goods, \( N_t \). This income tax rate or number of publicly provided intermediate goods, of course, must be decided by government. To do this, we must specify the government’s objective function. Once the government objective function is specified, the problem of government is a straightforward social planner’s problem. That is, government decides on the income tax rate or the number of publicly provided intermediate goods, so as to maximize its objective function, subject to the equilibrium laws of motion of the previous section and the government budget constraint. The solution to this problem is the so called politicoeconomic equilibrium.

First, we consider the case of the Median Voter Government, where the objective function of government is the objective function of the representative household. Moreover in order to simplify, henceforth, we consider the case where \( \gamma = \delta = 1 \). This is the case of logarithmic household preferences and full capital depreciation. Then, the equilibrium laws of motion (15) and (16), reduce to:

\[
c_t = (1-a\beta)[1-\hat{\psi}(N_{t+1} - N_t) - \hat{\psi}N_t]\xi(N_t)k_t^a
\]

(19)

\[
k_{t+1} = a\beta (1 + g_A)^{-1} [1-\hat{\psi}(N_{t+1} - N_t) - \hat{\psi}N_t]\xi(N_t)k_t^a
\]

(20)

And, the temporal utility function of the representative household becomes logarithmic, so that the objective function of the representative household and the so called Median Voter Government is given by:

\[
W^{MV} \left[ \{ k_{t+1}, N_{t+1} \}_{t=0}^{\infty}; (k_0, N_0) \right] = \sum_{t=0}^{\infty} \beta^t \ln c_t
\]

(21)

\[
= \sum_{t=0}^{\infty} \beta^t \ln \left[ (1-a\beta)[1-\hat{\psi}(N_{t+1} - N_t) - \hat{\psi}N_t]\xi(N_t)k_t^a \right]
\]

The problem of the Median Voter Government is to find a plan of the form \( \{ k_{t+1}, N_{t+1} \}_{t=0}^{\infty} \) so as to maximize (21), subject to (20). We shall refer to the solution of this problem as the Median Voter politicoeconomic equilibrium. It should be mentioned that the government budget constraint, is such that choosing the number of intermediate goods in the beginning of period \( t+1 \) completely

---

25 To verify this, observe that (20) comes as an implication of the resource constraint (16) and that (19) satisfies the Euler condition (15).
determines the income tax rate. Thus, this politicoeconomic equilibrium assumes that there is a commitment technology with respect to the income tax rate.\(^{26}\)

Second, motivated by the Greek paradigm, where political parties and governments have been dominated by unions and especially those of the greater public sector, we wish to consider a situation where insiders’ unions are controlling government.\(^{27}\) We shall refer to this type of government as Government of Insiders. But since in the equilibrium considered in the previous subsection and, in particular, in the Nash equilibrium characterizing the outcome of the insiders’ unions strategic interaction, we assumed that each union takes the number of publicly provided intermediate goods as given and beyond their control, it seems contradictory to argue that unions cooperate to control/influence government.\(^{28}\) However, there is no such contradiction. Unions “play” non-cooperatively vis-à-vis each other with respect to the wage rate, as an increase in the wage rate set by each union affects positively its own utility but negatively each other union. This is because, such an increase, due to the assumed gross complementarity, lowers labor demand facing all other unions. However, they still have an incentive to cooperate in influencing the income tax rate / the number of publicly provided intermediate goods. This is because a higher, say, income tax rate, increases the number of publicly provided intermediate goods and increases the demand for labor facing each union, also due to gross complementarity. Hence, all insiders’ unions have an incentive to increase this tax rate (financing of the underlying infrastructure). For that matter, unions’ interests are simultaneously to compete for wage premiums and cooperate for the number of publicly provided intermediate goods. On the contrary, however, in a world of no insiders, there is no need for such cooperation. We consider then the objective function of Insiders Government to be a function of the sum of utilities of all insiders’ unions, \(\sum_{i=0}^{\infty} \beta^i \ln \left[ \int_0^N w_i^j(z) - w_i^i(z) \right]^\lambda L_i^j(z) dz\), which in the symmetric case reduces to:

\[
W^{Gl}\left[\{k_{t+1}, N_{t+1}\}_{t=0}^{\infty};(k_0, N_0)\right] = \sum_{i=0}^{\infty} \beta^i \ln \left[ \nu(N_i) \xi(N_i) k_i^a \right]^\lambda = \sum_{i=0}^{\infty} \beta^i \left[ \lambda \ln \left( \frac{\nu(N_i)}{(1 - \alpha \beta) [1 - \psi(N_{t+1} - N_i) - \psi N_i]} + \lambda \ln c_i \right) \right] 
\]

(22)

where

\[
\nu(N_i) = \frac{[\nu(N_i) - 1]}{\nu(N_i)[1 - a - b + \nu(N_i)]^{[1 - 1/\lambda]}}
\]

(23)

\(^{26}\) Admittedly, here we avoid all problems that arise due to the lack of such commitment. See, e.g., Acemoglu (2009, Ch. 22), for what is referred to as the “hold up” problem.

\(^{27}\) Pertinent references are given in Kollintzas, et al. (2012).

\(^{28}\) This is what is referred to as “political elite” (see e.g., Acemoglu 2009, ch. 22). Elites are taken to make the political decisions and possibly engage in economic activities. In our case, the political elite consists of the members of insiders’ unions. Or, again, in Acemoglu’s terminology, we assume insiders’ unions to enjoy de facto political power.
The problem of the Government of Insiders is to find a plan of the form \( \{k_{t+1}, N_{t+1}\}_{t=0}^{\infty} \) so as to maximize (22), subject to (20). Clearly, then, Median Voter Government preferences depend on consumption of the representative household only. But, Government of Insiders preferences depend on a fraction, \( \lambda \), of the representative household preferences; the function \( \nu[v(N_i)] \), which, as will be shown in the proof of the next proposition, is an increasing and concave of the public sector wage premium, \( v(N_i) \); and government’s share of output, \( [1 - \psi(N_{t+1} - N_t) - \psi N_t] \). Interestingly, as can be seen from (23), this last dependence occurs in such a way so as to offset the effect of the government’s share of output incorporated in the consumption of the representative household.

Further, since we are interested in comparing societies with different politicoeconomic structures, we wish to consider a hybrid of the government objective functions introduced above. That is, following the political economy literature (see, e.g., Persson and Tabellini (2002), Ch. 7), we consider a government that to some degree is influenced by representative household preferences and is influenced, likewise, by insiders’ unions preferences. Thus, to avoid scale problems, we consider a government that seeks to minimize a weighted average of the percentage deviations of: (a) the welfare of the representative household from the welfare achieved under the solution of the Median Voter; and (b) the welfare of all insiders’ unions from the welfare achieved under the solution of the Government of Insiders:

\[
W^\rho = \rho \left[ \frac{W^{MV} - W^{MV} \left[ \{k_{t+1}, N_{t+1}\}_{t=0}^{\infty} ; (k_0, N_0) \} \right]}{W^{MV}} + (1 - \rho) \left[ \frac{W^{GI} - W^{GI} \left[ \{k_{t+1}, N_{t+1}\}_{t=0}^{\infty} ; (k_0, N_0) \} \right]}{W^{GI}} \right] \quad (24)
\]

subject to the capital law of motion (20), where \( 1 - \rho \in (0,1) \) is the relative influence of insiders’ unions on government. We shall refer to this problem as the problem of the Hybrid Government and to the solution of this problem as the Hybrid politicoeconomic equilibrium. Clearly, for \( \rho = 1 \) (\( \rho = 0 \)), the Hybrid politicoeconomic equilibrium collapses to the Median Voter (Government of Insiders) one. And, for an appropriate choice of \( \rho \in (0,1) \), the Hybrid equilibrium represents a politicoeconomic equilibrium with any given degree of insiders influence over the representative household in government decisions.

3. POLITICOECONOMIC EQUILIBRIUM

In this section we characterize the basic properties of the Hybrid politicoeconomic equilibrium. The following is the main result of this paper.

\[29\] We prove below that the solutions to the Median Voter government and the Government of Insiders exist, so that (24) is well defined.
Proposition 4 (Politicoeconomic equilibrium): Suppose \( \rho \in [0,1) \) or \( \rho = 1 \) and

\[
\frac{(1-a-b)(1-\zeta)[1-\zeta-\psi(1-a-b-\zeta)]}{(1-a-b-\zeta)\zeta} > (\beta^{-1}-1)\psi + \psi, \\
\]

Then, given Assumptions 1 and 2:

(a) The Hybrid politicoeconomic equilibrium is characterized by (20) and

\[
\phi(N_{t+1}) = \frac{\beta^{-1}\psi}{1-\psi(N_{t+1} - N_t) - \psi N_t} - \frac{\psi - \psi}{1-\psi(N_{t+2} - N_{t+1}) - \psi N_{t+1}}; \\
\]

where

\[
\phi(N_{t+1}) = A \frac{\xi'(N_{t+1})}{\xi(N_{t+1})} + B \frac{\nu'(N_{t+1})}{\nu(N_{t+1})}; \\
\]

with \((A, B) = \left( \frac{\rho + \lambda(1-\rho)}{\rho + \alpha \beta \lambda (1-\rho)}, \frac{(1-\alpha \beta) \lambda (1-\rho)}{\rho + \alpha \beta \lambda (1-\rho)} \right). \]

(b) There exists a unique steady state, \((k^\rho, N^\rho) \in (0, \infty) \times \left[ \frac{1-\alpha - b - \zeta}{1-\zeta}, \frac{1}{\psi} \right], \) associated with this equilibrium, such that:

\[
k^\rho = \left[ \frac{\alpha \beta (1-\psi N^\rho) \xi(N^\rho)}{1 + g_A} \right]^{\frac{1}{1-a}} \]

and \(N^\rho \) is the unique solution to:

\[
(1-\psi^\rho) \phi(N) = (\beta^{-1}-1)\psi + \psi, \\
\]

(c) Moreover, an increase in the relative influence of insiders’ unions, \( 1-\rho \), would lead to a higher steady state value, \( N^\rho \).

Proof: In the Appendix.\(^{30}\)

Difference equations (20) and (25) describe the transitional dynamics of the politicoeconomic equilibrium. Condition (25) is the key condition characterizing the transition of the number of publicly provided intermediate goods. As usual, these conditions characterize an intertemporal tradeoff of costs and benefits associated with a marginal increase in this number.

Now, the stage has been set to look into the steady state of the politicoeconomic equilibrium. This steady state is characterized by (27) and (28). Condition (28), that characterizes the steady state number of publicly provided intermediate goods, is crucial. As shown in the Appendix, \( \phi(N) \)

\[^{30}\]A discussion on the interpretation of the euler condition associated with the number of publicly provided intermediate goods can be found in Section 4 of the Complementary Technical Appendix
Figure 5. Illustration of existence and uniqueness of the steady state politicoeconomic equilibria.

is strictly positive, strictly decreasing, strictly concave, approaches $+\infty$ as $N \to \frac{1-a-b-\zeta}{1-\zeta}$ and becomes zero at $N = \frac{1}{\psi}$. These properties of $\varphi(N)$ imply that there exists a unique solution to (28) that gives the number of publicly provided intermediate goods in the steady state. In Figure 5 this steady state is in the intersection of the $(1-\psi N)\varphi(N)$ locus and the horizontal line at $(\beta^{-1}-1)\tilde{\psi} + \tilde{\psi}$. In this figure, there are three $(1-\psi N)\varphi(N)$ loci, one for each politicoeconomic equilibrium: $(1-\psi N)\varphi^{MV}(N)$ for the case of the Median Voter, $(1-\psi N)\varphi^{GI}(N)$ for the case of the Government of Insiders, and $(1-\psi N)\varphi^{p}(N)$ for the Hybrid politicoeconomic equilibrium case. Obviously, since $(1-\psi N)\varphi^{MV}(N) < (1-\psi N)\varphi^{GI}(N)$, the steady state number of publicly provided intermediate goods in the Median Voter politicoeconomic equilibrium, $N^{MV}$, is less than the corresponding number of the Government of Insiders politicoeconomic equilibrium, $N^{MV}$. The ordering between $N^{GI}$ and $N^{MV}$ is a manifestation of the “political effect” mentioned in the Introduction. Recall that the Median Voter solution incorporates the “labor misallocation” effect. So, steady state capital per efficient household in the Median Voter solution is already lower than the Second Best (i.e., the no wage premium but with distorting taxation Median Voter politicoeconomic equilibrium). Thus, while the Median Voter social planner chooses the number of publicly provided intermediate goods balancing (at the margin) the “variety” effect with the combination of the “labor misallocation” and
the “tax distortion” effects, the Government of Insiders chooses that number so as to balance the same effects but with greater values for these effects, due to the utility gains from the public sector wage premium and government’s share of output. For that matter, the Government of Insiders chooses a greater number of intermediate goods than the Median Voter social planner. In fact, as Part c of Proposition 4 makes clear, generally, an increase in insiders influence over government, \( (1 - \rho) \), would imply a higher steady state number of publicly provided intermediate goods.

For that matter and as illustrated in Figure 5, \( N^\rho \) falls always between \( N^{MV} \) and \( N^{GI} \).

Next, we turn on steady state capital, given by (27). Combining Propositions 3 and 4, it is apparent that there is no direct answer to the question whether there will be a higher or a lower steady state capital in the Median Voter social planner solution relative to the Government of Insiders solution. Nor, in the case of the Hybrid politicoeconomic equilibrium, how steady state capital will vary with an increase in the influence of insiders over government. In particular, for relatively low numbers of steady state publicly provided intermediate goods, \( N^\rho \), an increase in insiders influence over government, leading to a higher number of those goods in the steady state, may entail higher steady state capital and faster growth (i.e., growth along the convergence to the steady state). But, for a relatively higher number of steady state publicly provided intermediate goods, \( N^\rho \), a higher number for these goods leads to lower steady state output and growth. We summarize this important result in the following corollary.

**Corollary 3:** Consider two values of \( (1 - \rho) \), \( (1 - \rho') \) and \( (1 - \rho^*) \), such that \( (1 - \rho') > (1 - \rho^*) \). Suppose that \( (k^\rho, N^\rho) \) and \( (k^{\rho'}, N^{\rho'}) \) are the steady states defined in Proposition 4 that correspond to \( (1 - \rho') \) and \( (1 - \rho^*) \), respectively. If \( N^\rho, N^{\rho'} \in \left\{ \frac{(1-a-b)(1-\zeta)}{\psi [(1-a-b)(1-\zeta) + \zeta]} \cdot \frac{1}{\psi} \right\} \), so that \( \frac{d(1-\psi N)\xi(N)}{dN} < 0 \), \( k^\rho > k^{\rho'} \). And, if \( N^\rho', N^{\rho''} \in \left\{ \frac{1-a-b-\zeta}{1-\zeta}, \frac{(1-a-b)(1-\zeta)}{\psi [(1-a-b)(1-\zeta) + \zeta]} \right\} \) so that \( \frac{d(1-\psi N)\xi(N)}{dN} > 0 \), then \( k^{\rho''} < k^{\rho'} \).

Unfortunately, no clear cut answer can be obtained if \( N^{\rho'} \) is in the sub-interval of relatively large \( N \) and \( N^{\rho''} \) is in the sub-interval of relatively low \( N \).

Proposition 4 is helpful in explaining the stylized facts of the Introduction. For, if countries differ with respect to \( 1 - \rho \) (i.e., the relative weight of insiders in influencing the government), countries with high \( 1 - \rho \) will eventually have a high number of publicly provided intermediate goods and these countries will be more likely to have a number of publicly provided intermediate goods which
is higher than the threshold of Proposition 3. Then these countries will have lower steady state capital and output, than countries with relatively low $1 - \rho$.

We conclude this section with establishing that the Hybrid politicoeconomic equilibrium is at least asymptotically stable around the steady state. In particular, it is characterized by a sequence of numbers of publicly provided intermediate goods, $\{N_t\}_{t=0}^{\infty}$, converging monotonically to the steady state, for any $N_0$, sufficiently close to $N$.

**Proposition 5** (a) Let $\{N_t\}_{t=0}^{\infty}$ be the solution to (25) for any given $N_0$ and let $N$ be the unique steady state defined by (28). Around this steady state, the first order approximation of the solution to (25), $N_{t+1} = g(N_t), N = g(N)$, for some function $g(\cdot): \left(1 - \alpha - b - \zeta, \frac{1}{\psi} \right) \rightarrow \left(1 - \alpha - b - \zeta, \frac{1}{\psi} \right)$, is given by:

$$N_{t+1} = g(N_t) \cap (1 - \sigma)N + \sigma N_t,$$

where,

$$\sigma = \frac{1}{2} \left[ \beta^{-1} \frac{\psi - \hat{\psi}}{\psi - \hat{\psi}} + \frac{1 - \psi N}{\psi} \varphi'(N) \right] - \frac{1}{4} \left\{ \left[ \beta^{-1} \frac{\psi - \hat{\psi}}{\psi - \hat{\psi}} + \frac{1 - \psi N}{\psi} \varphi'(N) \right]^2 - 4\beta^{-1} \right\}^{1/2}. $$

$$\in \left(0, \frac{\psi - \hat{\psi}}{\psi} \right) \subset (0,1)$$

Proof: In the Appendix.

Since, $\sigma \in \left(0, \frac{\psi - \hat{\psi}}{\psi} \right)$, it follows that the convergence of the number of publicly provided intermediate goods to its steady state, $N$, is monotonic. Moreover, it follows from (20) and (29) that around the steady state $(k, N)$ of the politicoeconomic equilibrium, the law of motion of capital can be approximated by:

$$k_{t+1} = a \beta \left(1 + g_A \right)^{-1} \{1 - (1 - \sigma)\hat{\psi}N + [(1 - \sigma)\psi - \hat{\psi}]N_t \} \xi(N_t) k_t^a$$

And, since $\sigma \in \left(0, \frac{\psi - \hat{\psi}}{\psi} \right)$, $(1 - \sigma)\psi - \hat{\psi} > 0$ and therefore the convergence of capital is also monotonic.
4. STYLIZED FACTS EXPLANATIONS AND THE CASE OF A GROWTH REVERSAL

Recall from Proposition 4, that an increase in insiders influence over government (i.e., \( 1 - \rho \)) will lead to an increase in the steady state number of publicly provided intermediate goods, \( N \). Further, recall from Proposition 3 that steady state TFP, \((1 - \hat{\psi} N)\xi(N)\), does not change monotonically with the steady state number of publicly provided intermediate goods, \( N \). That is, for a relatively low \( N \), an increase in this number is associated with the dominance of the “variety” effect over the combination of the “labor misallocation” and the “political effect,” while the opposite is true after a certain threshold, \( \hat{N} \). These results, along with the monotonic convergence of \( \{k_t, N_t\}_{t=0}^{\infty} \) towards \((k, N)\), established in Proposition 5, allow for the possibility of a growth reversal, brought about by an increase in insiders influence over government. Despite the fact that here we have two state variables, this possibility can be illustrated with the help of the standard neoclassical growth phase diagram.

Figure 6: A Growth Reversal

In Figure 6, the horizontal axis measures capital in the current period and the vertical axis measures capital in the next period. For any given \((k_t, N_t)\) in the current period, capital in the next period is given by \( \frac{\alpha \beta}{1 + g_A} \left[ (1 - \hat{\psi} N)\xi(N)k_t^a \right] \), like point A in Figure 6. The steady state of capital is given by the intersection of the \(45^0\) line and the locus \( \frac{\alpha \beta}{1 + g_A} (1 - \hat{\psi} N) \xi(N)k^a \),
where \( N = g(N). \) Suppose, now, that \( N \leq \bar{N}, \) where \( \bar{N} \) is the threshold value (i.e.,
\[
\frac{d(1-\hat{\psi}N)\bar{\xi}(\bar{N})}{dN} = 0 \quad \text{and for } N \text{ below (above) } \bar{N}, \quad \frac{d(1-\hat{\psi}N)\bar{\xi}(N)}{dN} > 0 (< 0).
\]
Clearly, the locus
\[
\frac{a\beta}{1+g_A}(1-\hat{\psi}\bar{N})\bar{\xi}(\bar{N})k^a
\]
as long as \( N_i < \bar{N}, \) lies above any transition locus
\[
\frac{a\beta}{1+g_A}[1-\hat{\psi}(g(N_i)-N_i)\bar{\xi}(N_i)k_i^a].
\]
It also follows, as it can be readily seen from (30), that
as long as \( N_i < N_{i+1}, \) next period capital will be given by a higher transition locus than that giving
the current period capital. It follows that capital is moving along a rising trajectory, like the dotted line in Figure 4. Suppose, now, that while capital is at \( C, \) there is an increase in insiders influence,
so that the new steady state is \( \bar{N}, \) where \( \bar{N} < \bar{N}. \) Clearly, since the steady state locus
\[
\frac{a\beta}{1+g_A}(1-\hat{\psi}\bar{N})\bar{\xi}(\bar{N})k^a
\]
is also an upper bound to all steady state loci, the new steady state locus,
\[
\frac{a\beta}{1+g_A}(1-\hat{\psi}\bar{N})\bar{\xi}(\bar{N})k^a
\]
is below the first. For a sufficient increase in insiders’ power over
government, point \( C \) maybe above the new steady state locus, \( \frac{a\beta}{1+g_A}(1-\hat{\psi}\bar{N})\bar{\xi}(\bar{N})k^a. \) For
precisely the same reasons like the ones used to establish the dotted trajectory, now capital will
follow a falling trajectory, like the dashed trajectory from \( C \) to \( D, \) establishing the growth reversal
in the case of a rising influence of insiders over government.

This growth reversal possibility serves as an explanation of what may have occurred in
Greece. That is, the growth reversal observed in Figure 1 might be simply a consequence of the
increasing influence of insiders in Greek society. In the model’s framework, one may think of
Greece, as a country with a low initial level of \( N, \) but with a progressively higher \( 1-\rho, \) as
insiders’ influence over government grew stronger. Thus, about forty years ago, the advent of the
insiders-outsiders society in Greece, which was at a lower stage of development and was lacking
adequate infrastructures, may have helped the economy to develop and grow. This happened
precisely because, it led to the public provision of that infrastructure, when the private provision of
the latter seemed infeasible. But, eventually, the insiders-outsiders society may have exceeded its
usefulness and insiders’ unions enjoyed substantial wage premia, leading to labor misallocation and
tax distortion and/or high debt, that caused the Greek crisis.\(^{31}\)

\(^{31}\) Most Southern European countries exhibited negative growth for a number of years after the 2008 crisis. According
to our theory, the growth reversal is an outcome that should follow a period of relatively low growth. Clearly, Greece
conforms to this prediction, with a very deep recession following a period of meagre growth. A similar but more gentle
pattern characterizes the other South European countries, as well.
In fact, the overwhelming resistance and procrastination of public sector unions and practically all Greek governments in recent years in the implementation of the reforms requested by Greece’s lenders incorporated in the various bailout programs (memorandum of understanding - “μνημόνια”) can clearly be attributed to the very existence of the insiders-outsiders society as described in this paper.

An indication of the increase in the influence of insiders over government in Greece is the very high public sector wage premia as seen below in Figure 7.32

Figure 7: Public Sector Wage Premium

![Public Sector Wage Premium Graph]

Note: Data sources and definitions in the Appendix.

Also, credence to the validity of the model are the stylized facts reported in Figure 8. Namely, that wages in the public sector relative to the private sector are not only high but these wage differentials correlate negatively with general government employment over total employees, total factor productivity, and output growth.33

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32 The public sector wage premium is defined as the ratio of the average wage rate in the public sector over the average wage rate in the private sector. An even more dramatic picture would have emerged, if time series data on the average wage rate in public sector enterprises were available (which, to our knowledge, are not). This would be the case especially for Greece where circumstantial evidence (e.g., annual reports of the National Electric Power Company (ΔΕΗ)) suggests that wages in the public sector enterprises are considerably higher than average public sector wages (See Kollintzas, et al. (2016))

33 The substantial public sector wage premium in Greece is also a feature identified in micro-data and remain a persisting feature even in the advent of the recent crisis (See e.g. Christopoulou and Monastiriotis (2014) and (2016)). Also, recently, there have been several studies that show empirically that, not only Greece, but also Portugal, Spain, Italy, and Ireland exhibit higher public sector wage premia than other Euro Area countries. See, for example, Giordano et al. (2011), De Castro, et al. (2013) and Campos, et al. (2015).
First, the wage premium in the public sector is justified and related to union power, production technology, especially the degree of complementarity among publicly provided intermediate goods and the degree of government involvement in the economy, with the number of publicly provided intermediate goods thought to be a proxy of the latter (Proposition 1). Second, it provides for an explanation for the negative correlation between public sector wage premium and the ratio of public over total employment (Corollary 1). Third, it provides for an explanation for the negative correlation between public sector wage premium and after tax TFP (Proposition 3). Finally, the negative correlation between public sector wage premium and output growth can be decomposed into two parts: for a given country over time, it can be explained by growth reversal arguments similar to the ones discussed above, brought about by the advent of the insiders-outsiders society. And, for different countries, this negative correlation can be attributed to the degree their economies are characterized by the insiders-outsiders society. For example, one may think of Greece or other South European countries having very high $\lambda$ and very high $1 - \rho$, so that the threshold of $N$, in Proposition 3, is exceeded, while countries with very low or non-existent wage premia in the public sector, the Anglo-Saxon countries (except Australia before the millennium), for example, having very low $\lambda$ and very low $1 - \rho$, so that steady state $N$ is below this threshold. For some other countries the model’s structure may be altogether inappropriate. For example, the Nordic countries, where wage premia in the public sector are practically negligible, have very strong unions in both public and private sectors, but their unions co-operate to internalize the cost to the economy associated with a high wage premium in one industry or sector. In our model’s jargon this, practically means that outsiders behave like insiders and the Government of Insiders behaves like the Median Voter. All of these cases (as well as other questions, see, e.g., footnote 15),

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34 See European Commission (2013, 2014) and Kollintzas et al. (2015), for related country clusterings.
however, could be addressed by an extension of our model that incorporates a sector of privately provided intermediate goods and their corresponding unions, along the lines of Cole and Ohanian (2004). In such an environment, we could also incorporate professional associations and the regulated prices and tax breaks they manage to get for their members. In a way, the present model can be readily modified to incorporate these professional associations. For example, treating a fixed number of professional associations as unions of intermediate good producers, that each one of them behaves like a monopolist in their respective market and all together cooperate so as to get tax breaks, results in a simplified version of our model, where, in the symmetric case, there is a fixed wage premium enjoyed by professional association members; and there is a tax rate gap between professional association members and the rest of society, that is increasing in the share of government spending over GDP. Last but not least, it would be interesting to complement the above framework with the incorporation of a political economy mechanism that determines who wins elections and forms a government and investigate how the allocation of insiders and outsiders is affected by such a mechanism.

5. CONCLUSIONS

In a synthesis of the insiders-outsiders labor market structure and the concept of an elite government, we constructed a dynamic general equilibrium model of market and political power interactions that can explain the growth reversal characterizing Greece in recent years. In this country public sector unions act independently in their respective markets, but co-operate to influence government policies, including those that affect public sector infrastructures. In so doing, they increase taxes and/or debt to inefficient levels. Moreover, the model is consistent with several stylized facts pertaining to the wage premium in the public sector, such as: the negative correlation between the public sector wage premium, on the one hand, and the ratio of public sector employment over total employment, total factor productivity, and output growth, on the other hand. Finally, this model may be of interest to understand growth performance in other developed or developing countries sharing similar institutional frictions with Greece.

ACKNOWLEDGEMENTS

We are grateful to Assar Lindbeck and Fabrice Collard for valuable comments. Dimitris Papageorgiou and Vanghelis Vassilatos gratefully acknowledge co-financing of this research by the European Union (European Social Fund — ESF) and Greek national funds through the Operational Program “Education and Lifelong Learning” of the National Strategic Reference Framework (NSRF) — Research Funding Program ARISTEIA II_Public Sector Reform, Research Grant, No 5328. The views expressed in this paper are those of the authors and do not necessarily reflect those of the Bank of Greece.
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APPENDIX

Proof of Proposition 2

Part a

Given Assumptions 1 and 2, \( v(N) > 1, \ \forall N \in \left( \frac{1 - \alpha - b - \zeta}{1 - \zeta}, \infty \right) \). Therefore, it follows from definition (18), that \( \xi(N) > 0, \ \forall N \in \left( \frac{1 - \alpha - b - \zeta}{1 - \zeta}, \infty \right) \). Fix \( N = \bar{N} \in \left( \frac{1 - \alpha - b - \zeta}{1 - \zeta}, \infty \right) \) and consider \( \xi \) as a function of \( \bar{v} = v(\bar{N}) > 1 \). That is, let:

\[
\xi(\bar{N}) = \xi\left[ v^{-1}(\bar{N}) \right] = \xi(\bar{v}) = b^b(1 - a - b)^{1 - a - b} N \left( \frac{1 - a - b - \zeta}{\zeta} \right) \frac{\bar{v}^b}{[1 - a - b + b\bar{v}]^{1 - a}}
\]

And, therefore, given Assumptions 1 and 2,

\[
\frac{\partial \xi}{\partial \bar{v}} \bigg|_{N=\bar{N}} = \bar{v}(\bar{v}) = b^b(1 - a - b)^{1 - a - b} \Phi^{1 - a - b} N \left( \frac{1 - a - b - \zeta}{\zeta} \right) \frac{(1 - a - b)b\bar{v}^{b-1}(1 - \bar{v})}{[1 - a - b + b\bar{v}]^{2(1-a)}} < 0.
\]

Part b

Differentiate \( \xi(N) \) with respect to \( N \), to get:

\[
\xi'(N) = \frac{1 - a - b}{N} \left\{ 1 - \zeta - \frac{b\xi'(N)N[v(N)-1]}{\zeta} \right\} \chi(N) = (1 - a - b) \frac{\xi(N)}{N} \chi(N)
\]

where:

\[
\chi(N) = \frac{1 - \zeta}{\zeta} - \frac{\lambda b(1 - a - b - \zeta)\nu(N)[v(N)-1]}{N[1 - a - b + b\nu(N)]}
\]

(A.2.1)

(A.2.2)

Clearly, then, given Assumptions 1 and 2,

\[
\xi'(N) \geq 0 \text{ as } \chi(N) \geq 0, \text{ or as } \varphi(N) \leq 0, \text{ where: } \varphi(N) = \nu(N)^2 - [1 + \nu(N)]\nu(N) - \frac{1 - a - b}{b} \hat{\nu}(N),
\]

and, \( \hat{\nu}(N) = \frac{(1 - \zeta)N}{\lambda \zeta (1 - a - b - \zeta)} > 0 \). But, given Assumptions 1 and 2, \([1 + \hat{\nu}(N)] > \nu(N)\), \( \forall N \in \left( \frac{1 - \alpha - b - \zeta}{1 - \zeta}, \infty \right) \). To see this, note that \( \nu(N) = 1 \), for \( N = \frac{1 - \alpha - b - \zeta}{1 - \zeta} \). And, by Proposition 1, it is strictly increasing, strictly concave, and approaches asymptotically as \( N \to \infty \). On the other hand, \([1 + \hat{\nu}(N)] = 1 + \frac{1}{\lambda \zeta} > \frac{1}{1 - \lambda (1 - \zeta)} \) for
\( N = \frac{1-\alpha-b-\zeta}{1-\zeta} \) and increases at a constant rate, throughout \( \left( \frac{1-\alpha-b-\zeta}{1-\zeta}, \infty \right) \). Therefore, given Assumptions 1 and 2, \( \varphi(N) < 0 \), \( \forall N \in \left( \frac{1-\alpha-b-\zeta}{1-\zeta}, \infty \right) \) and hence \( \xi'(N) > 0 \).

\( \forall N \in \left( \frac{1-\alpha-b-\zeta}{1-\zeta}, \infty \right) \).

Q.E.D.

**Proof of Proposition 3**

Note that:

\[
\frac{d(1-\psi N)\xi(N)}{dN} > 0 \quad \text{as} \quad \frac{\xi'(N)\xi(N)}{\xi(N)} = \frac{\psi N}{1-\psi N}
\]

Therefore, in view of (A.2.1) and (A.2.2), we have:

\[
\frac{d(1-\psi N)\xi(N)}{dN} < 0 \quad \text{as} \quad \Re \left[ v(N), N \right] > 0
\]

where

\[
\Re \left[ v(N), N \right] \equiv v(N)^2 - \left[ 1 + \tilde{v}(N) \right] v(N) - \frac{1-a-b}{b} \tilde{v}(N)
\]

and

\[
\tilde{v}(N) \equiv \left[ \frac{1-\zeta}{\zeta} - \frac{\psi N}{(1-a-b)(1-\psi N)} \right] \frac{\psi N}{\lambda \psi (1-a-b-\zeta)}
\]

Given Assumptions 1 and 2, \( 0 < \frac{1-\alpha-b-\zeta}{1-\zeta} < 1 \) and in view of the facts that \( \tau = \psi N \) and \( 0 < \tau \leq 1, \) \( N \) is restricted to be in the interval \( N_i \equiv (N_1, \bar{N}_1) \equiv \left( \frac{1-\alpha-b-\zeta}{1-\zeta}, \frac{1}{\psi} \right) \). Note, then, that if \( N \in N_2 \equiv \left[ N_2, \bar{N}_2 \right] \equiv \left[ \frac{1-a-b}{\psi \left[ (1-a-b)(1-\zeta) + \frac{1}{\psi} \right]} \right], \quad \tilde{v}(N) \leq 0 \). And, since Assumptions 1 and 2 imply that \( v(N) \geq 1, \forall N \in N_1 \), it follows that \( \Re \left[ v(N), N \right] > 0, \forall N \in N_1 \cap N_2 = \left[ \max \{ N_1, N_2 \}, \bar{N}_2 \right] \).

Hence, \( \frac{d(1-\psi N)\xi(N)}{dN} < 0, \forall N \in N_1 \cap N_2 \). Further, observe that if \( N_2 \leq N_1, \) \( N_1 \cap N_2 = N_1 \) and there is no other case left to consider. Thus, suppose that \( N_2 > N_1 \) and consider the case where
\( N \in \mathbb{N}_3 = (N_3, \overline{N}_3) = (N_1, N_2) \). Clearly, in this case \( \overline{v}(N) > 0, \forall N \in \mathbb{N}_3 \). It follows that \( \Re[\nu(N), N] \) may be factored as follows: 
\[
\Re[\nu(N), N] = [\nu(N) - \overline{v}(N)][\nu(N) - \underline{v}(N)]
\]
where \( \nu(N), \overline{v}(N) : \mathbb{N}_3 \to \mathbb{R} \), such that:
\[
-\nu(N), \overline{v}(N) > 0
\]
\[
\nu(N)\overline{v}(N) = \frac{1 - \alpha - b}{b} \overline{v}(N) < 0
\]
Therefore, \( \Re[\nu(N), N] < 0 \), for all \( N \in \mathbb{N}_3 \), if and only if \( 1 \leq \nu(N) < \overline{v}(N) \), for all \( N \in \mathbb{N}_3 \).

In this case, of course, \( \frac{d(1-\overline{\psi}N)\xi(N)}{dN} > 0 \), \( \forall N \in \mathbb{N}_3 \). To complete the proof, it suffices to show that there exists a non-empty sub-interval of \( \mathbb{N}_3 \) such that \( 1 \leq \nu(N) < \overline{v}(N) \). To show this, first observe that \( 1 \leq \nu(N) < \overline{v}(N), \forall N \in \mathbb{N}_1 \), if and only if \( 1 \leq \nu(N) < 1 + \overline{v}(N) + \varepsilon \), \( \forall N \in \mathbb{N}_3 \), where \( 0 < \varepsilon < \sup[-\nu(N)] \). Recall that \( \nu(N) : \mathbb{N}_1 \to (1, \nu(\overline{N}_1)) \) is strictly increasing throughout its domain and \( \nu(\overline{N}_1) = \nu(\overline{N}_1) = 1 \). Consider, now, any sufficiently small \( \varepsilon \in \left(0, \sup_{N \in \mathbb{N}_3}[-\nu(N)]\right) \) and observe that there exists a \( \overline{N}_4(\varepsilon) \in \mathbb{N}_3 \) and \( \overline{N}_4(\varepsilon) > \overline{N}_3 \) such that \( \nu(\overline{N}_4(\varepsilon)) = 1 + \varepsilon \). Clearly, then, \( 1 \leq \nu(N) < 1 + \overline{v}(N) + \varepsilon \) for all \( N \in \mathbb{N}_4(\varepsilon) = (N_4(\varepsilon), \overline{N}_4(\varepsilon), (\overline{N}_4(\varepsilon), 1) \subset \mathbb{N}_3 \) (See Figure A.1).

Q.E.D.

Figure A.1: An illustration of the sub-interval of \( \mathbb{N}_1 \), where \( \frac{d(1-\overline{\psi}N)\xi(N)}{dN} < 0 \), \( N_2 \), and the sub-interval of \( \mathbb{N}_1 \), where \( \frac{d(1-\overline{\psi}N)\xi(N)}{dN} > 0 \), \( N_4(\varepsilon) \).
**Proof of Proposition 4**

**Part a**

The Euler – Lagrange conditions associated with the Hybrid politicoeconomic equilibrium are given by:

\[
[\rho \alpha \beta + (1 - \rho)\alpha \beta \lambda]k_{t+1} - \mu_t (1 + g_A) + a \beta \mu_{t+1} \left[1 - \dot{\psi}(N_{t+2} - N_{t+1}) - \ddot{\psi} N_{t+1}\right] \xi(N_{t+1}) k_{t+1}^a = 0
\]

(A.4.1)

and

\[-\beta^{-1} \rho \psi \left[1 - \ddot{\psi}(N_{t+1} - N_t) - \dot{\psi} N_t\right]^{-1} + \rho \left\{ \left( \ddot{\psi} - \dot{\psi} \right) + \left[1 - \ddot{\psi}(N_{t+2} - N_{t+1}) - \dot{\psi} N_{t+1}\right] \xi'(N_{t+1}) \right\} \left[1 - \ddot{\psi}(N_{t+2} - N_{t+1}) - \dot{\psi} N_{t+1}\right]^{-1} + \lambda(1 - \rho) \left[ \frac{\psi'(N_{t+1})}{\psi(N_{t+1})} + \frac{\xi'(N_{t+1})}{\xi(N_{t+1})} \right] - \beta^{-1} \mu_t a \beta \ddot{\psi} \xi(N_t) k_t^a + \mu_{t+1} a \beta \left[ \ddot{\psi} - \dot{\psi} \right] + \left[1 - \ddot{\psi}(N_{t+2} - N_{t+1}) - \dot{\psi} N_{t+1}\right] \xi'(N_{t+1}) \xi(N_{t+1}) k_{t+1}^a = 0
\]

(A.4.2)

where \( \mu_t \) is the Lagrange multiplier associated with (20).

In view of (20), (A.5.1) can be rewritten as:

\[\mu_t (1 + g_A) k_{t+1} = [\rho \alpha \beta + (1 - \rho)\alpha \beta \lambda] + a \beta \mu_{t+1} (1 + g_A) k_{t+2} = 0\]

(A.4.3)

Solving (A.5.3) forward and provided that \( \lim_{u \to \infty} (a \beta)^u \mu_{t+u} (1 + g_A) k_{t+u+1} = 0 \) gives:

\[\mu_t (1 + g_A) k_{t+1} = \frac{\rho \alpha \beta + (1 - \rho)\alpha \beta \lambda}{1 - a \beta}
\]

(A.4.4)

We verify that (A.5.4) satisfies \( \lim_{u \to \infty} (a \beta)^u \mu_{t+u} (1 + g_A) k_{t+u+1} = \frac{\rho \alpha \beta + (1 - \rho)\alpha \beta \lambda}{1 - a \beta} \lim_{u \to \infty} (a \beta)^u = 0 \), since \( a, \beta \in (0,1) \).

Therefore,

\[\mu_t = \frac{\rho \alpha \beta + (1 - \rho)\alpha \beta \lambda}{(1 - a \beta)(1 + g_A) k_{t+1}}\]

(A.4.5)

Then, in view of (A.5.5), (A.5.2) gives:

\[\varphi(N_{t+1}) = \frac{\beta^{-1} \ddot{\psi}}{1 - \ddot{\psi}(N_{t+1} - N_t) - \dot{\psi} N_t} - \frac{\ddot{\psi} - \dot{\psi}}{1 - \ddot{\psi}(N_{t+2} - N_{t+1}) - \dot{\psi} N_{t+1}};\]

(A.4.6)

where

\[\varphi (N_{t+1}) = A \frac{\xi'(N_{t+1})}{\xi(N_{t+1})} + B \frac{\psi'(N_{t+1})}{\psi(N_{t+1})};\]

(A.4.7)

with
\[(A, B) = \left( \frac{\rho + \lambda (1 - \rho)}{\rho + \alpha \beta \lambda (1 - \rho)}, \frac{(1 - \alpha \beta \lambda)(1 - \rho)}{\rho + \alpha \beta \lambda (1 - \rho)} \right). \] (A.4.8)

**Part b**

Let any steady state defined by:

\[... k_{r-1} = k_i = k_{r+1} = ... = k^\rho; \]
\[... N_{r-1} = N_i = N_{r+1} = ... = N^\rho. \]

It follows from (20) and (A.5.6) that any steady state must satisfy:

\[k^\rho = \left[ \frac{\alpha \beta (1 - \hat{\psi} N^\rho) \xi(N^\rho)}{1 + g_A} \right]^{1-a} \] (A.4.9)

and

\[(1 - \hat{\psi} N^\rho) \phi''(N^\rho) = (\beta^{-1} - 1) \hat{\psi} + \hat{\psi} \] (A.4.10)

To prove the existence and uniqueness of the steady state, first note that the RHS of (A.4.10) is a positive constant, \((\beta^{-1} - 1) \hat{\psi} + \hat{\psi}\) and the LHS in this equality is

\[(1 - \hat{\psi} N) \varphi(N) = A(1 - \hat{\psi} N) \frac{\xi'(N)}{\xi(N)} + B(1 - \hat{\psi} N) \frac{\nu'(N)}{\nu(N)}, \text{ where } A > 0 \text{ and } B \geq 0, \text{ with } B = 0 \text{ if and only if } \rho = 1. \]

Consider first the function \((1 - \hat{\psi} N) \frac{\xi'(N)}{\xi(N)}\). It was shown in the proof of Proposition 2, that, given Assumptions 1 and 2,

\[(1 - \hat{\psi} N) \frac{\xi'(N)}{\xi(N)} = (1 - a - b)(1 - \hat{\psi} N) \left[ 1 - \frac{1 - \zeta}{\xi(N)} - \frac{b \nu'(N) [v(N) - 1]}{\nu(N) [1 - a - b + b \nu(N)]} \right] > 0, \forall N \in \mathbb{N}. \] (A.4.11)

Further, recall from Proposition 1 that, given Assumptions 1 and 2:

\[\nu'(N_i) = \frac{\lambda (1 - a - b - \zeta) \nu(N_i)^2}{N_i^2} > 0, \quad \nu''(N_i) = \frac{-2 \lambda (1 - a - b - \zeta) [1 - \lambda (1 - \zeta)] \nu(N_i)^3}{N_i^3} < 0, \quad \text{and} \]
\[\nu(N^\infty) = \frac{6 \lambda (1 - a - b - \zeta) [1 - \lambda (1 - \zeta)]^2 \nu(N)^4}{N^4} > 0. \]

Also, recall from Proposition 2, that given Assumptions 1 and 2,

\[(1 - \hat{\psi} N) \frac{\xi'(N)}{\xi(N)} \to \frac{(1 - a - b)(1 - \zeta)^2}{(1 - a - b - \zeta) \zeta} \left( 1 - \hat{\psi} \frac{1 - \alpha - b - \zeta}{1 - \zeta} \right) > 0, \text{ as } N \to N_i \text{ and } (1 - \hat{\psi} N) \frac{\xi'(N)}{\xi(N)} \to 0 \text{ as } N \to \tilde{N}_1. \]

Next, consider, the function \((1 - \hat{\psi} N) \frac{\nu'(N)}{\nu(N)}\), where

\[\nu(N) = \frac{[\nu(N) - 1]}{\nu(N_i) [1 - a - b + b \nu(N)]^{1 - \lambda / \alpha}}. \]

It follows that:
\( (1-\hat{\psi}N) \frac{\nu'(N)}{\nu(N)} = \frac{\lambda(1-a-b-\zeta)v(N)^2}{N^2}(1-\hat{\psi}N) \left\{ \frac{1}{v(N)[v(N)-1]} - \frac{(1-\lambda)b}{\lambda[1-a-b+bv(N)]} \right\} \) (A.4.12)

Using the above stated properties of \( \nu(N) \), it follows by tedious but otherwise straightforward algebra, that given Assumptions 1 and 2, \( \frac{d[\xi'(N)/\xi(N)]}{dN} < 0, \frac{d^2[\xi'(N)/\xi(N)]}{dN^2} > 0, \frac{\nu'(N)}{\nu(N)} > 0 \), \( \frac{d[\nu'(N)/\nu(N)]}{dN} < 0, \frac{d^2[\nu'(N)/\nu(N)]}{dN^2} > 0 \) \( \forall N \in \left( N_1, \bar{N}_1 \right) \). Furthermore, it follows from (A.5.12) that \( (1-\hat{\psi}N) \phi(N) > 0, \frac{d[(1-\hat{\psi}N)\phi(N)]}{dN} < 0, \frac{d^2[(1-\hat{\psi}N)\phi(N)]}{dN^2} > 0 \) \( \forall N \in \left( N_1, \bar{N}_1 \right) \). Moreover, \( (1-\hat{\psi}N)\phi(N) \to 0 \) as \( N \to \bar{N}_1 \). Furthermore, as long as \( \rho < 1 \), \( (1-\hat{\psi}N)\phi(N) \to +\infty \) as \( N \to N_1 \); and when \( \rho = 1 \), in which case \( (1-\hat{\psi}N)\phi(N) = (1-\hat{\psi}N) \frac{\xi'(N)}{\xi(N)} \), Assumption 3 implies that \( (1-\hat{\psi}N)\phi(N) \to \frac{(1-a-b)(1-\zeta)^2}{(1-a-b-\zeta)\zeta} \frac{(1-\hat{\psi}-\lambda(b-1)\hat{\psi}+\hat{\phi})}{1-\zeta} \) as \( N \to N_1 \). Hence, under the stated assumptions, \( (1-\hat{\psi}N)\phi(N) \) is continuous, positive, strictly decreasing and strictly concave, \( \forall N \in \left( N_1, \bar{N}_1 \right) \). Further it takes a value greater than, \( [(\beta^{-1}-1)\hat{\psi}+\hat{\phi}] > 0 \) as \( N \to N_1 \); and takes the value 0, as \( N \to \bar{N}_1 \). Therefore, \( (1-\hat{\psi}N)\phi(N) \) takes the value \( (\beta^{-1}-1)\hat{\psi}+\hat{\phi} \) at a unique point in the open interval \( \left( N_1, \bar{N}_1 \right) \), \( N^* \). And, therefore, \( k^* \in (0, \infty) \), defined by (A.4.9), is also unique.

**Part c**

Note that \( \rho \) affects \( (1-\hat{\psi}N)\phi(N) \) only through \( A \) and \( B \). Then, since both of these constants are strictly decreasing functions of \( \rho \) and \( (1-\hat{\psi}N)\phi(N) \) is strictly increasing in both \( A \) and \( B \), it is immediate from Part b, that an increase in \( 1-\rho \) increases the steady state value of value of \( N, N^* \).

Q.E.D.
Proof of Proposition 5

Let:
\[
h(N_t, N_{t+1}, N_{t+2}) = \varphi(N_{t+1}) - \frac{\beta^{-1} \psi}{1 - \psi (N_{t+1} - N_t)} + \frac{\psi - \hat{\psi}}{1 - \psi (N_{t+2} - N_{t+1}) - \hat{\psi} N_{t+1}}
\]  
(A.5.1)

Then,
\[
h(N_t, N_{t+1}, N_{t+2}) = 0
\]  
(A.5.2)

is equivalent to (A.4.6). And,
\[
h(N, N, N) = 0
\]  
(A.5.3)

is equivalent to (A.4.10).

Taking a first order approximation of \( h(N_t, N_{t+1}, N_{t+2}) \) around \( h(N, N, N) \), we have:
\[
h(N_t, N_{t+1}, N_{t+2}) \approx h(N, N, N) + h_1(N, N, N)(N_{t+2} - N) + h_2(N, N, N)(N_{t+1} - N) + h_3(N, N, N)(N_t - N) = 0
\]  
(A.5.4)

where \( h_i(N, N, N) \), \( i = (1, 2, 3) \) denote the partial derivatives of \( h \) with respect to its first, second and third argument, respectively, evaluated at \( (N, N, N) \). In view of (A.5.3), (A.5.4) yields:
\[
\frac{\psi (\psi - \hat{\psi})}{(1 - \psi N)^2} (N_{t+2} - N) - \left[ \frac{\beta^{-1} \psi^2}{(1 - \psi N)^2} + \frac{(\psi - \hat{\psi})^2}{(1 - \psi N)^2} - \varphi'(N) \right] (N_{t+1} - N) + \frac{\beta^{-1} \frac{\psi (\psi - \hat{\psi})}{1 - \psi N}}{(1 - \psi N)^2} (N_t - N) = 0
\]  
(A.5.5)

It follows that the characteristic equation associated with (A.5.5) is:
\[
\sigma^2 - \left[ \frac{\beta^{-1} \psi^2}{\psi - \hat{\psi}} + \frac{(1 - \psi N)^2}{\psi (\psi - \hat{\psi})} \varphi'(N) \right] \sigma + \beta^{-1} = 0
\]

This equation has two roots, \( \sigma \in \left( 0, \frac{\psi - \hat{\psi}}{\psi} \right) \subset (0, 1) \) and \( (\sigma \beta)^{-1} > 1 \). Then, since \( N_t \) is restricted to be in the interval \( \left( \frac{1 - \alpha - b - \zeta}{1 - \zeta}, \frac{1}{\psi} \right) \), the unique solution of (A.5.5) is given by:
\[
N_{t+1} - N = \sigma (N_t - N)
\]  
(A.5.6)

where:
\[
\sigma = \frac{1}{2} \left[ \left( \frac{\beta^{-1} \psi^2}{\psi - \hat{\psi}} + \frac{(1 - \psi N)^2}{\psi (\psi - \hat{\psi})} \varphi'(N) \right) - \left( \frac{\beta^{-1} \psi^2}{\psi - \hat{\psi}} + \frac{(1 - \psi N)^2}{\psi (\psi - \hat{\psi})} \varphi'(N) \right)^2 - 4 \beta^{-1} \right]^{1/2}
\]

Q.E.D.
DATA APPENDIX

The data set includes nineteen OECD individual countries (Australia, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Ireland, Netherlands, Portugal, Spain, Canada, Japan, Norway, Sweden, UK and US.), as well as total OECD. Data are yearly and cover a maximum time span from 1970 to 2015. Our main data source is the OECD Economic Outlook no. 90. Missing values for some specific time periods/variables have been completed from the OECD Economic Outlook no. 88, 86, 85 and AMECO. Other data sources are the OECD Aggregate National Accounts, OECD.stats, OECD-Product Market Regulation 2013 and ICTWSS Data base, Version 5.0, October 2015 (Data base on Institutional Characteristics of Trade Unions, Wage Setting, State Intervention and Social Pacts, Visser (2015))

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<tr>
<td>Union density in the public sector</td>
<td>ICTWSS Data base. version 5.0</td>
</tr>
<tr>
<td>Union density in the private sector</td>
<td>ICTWSS Data base. version 5.0</td>
</tr>
<tr>
<td>State control index</td>
<td>OECD-Product Market Regulation 2013</td>
</tr>
<tr>
<td>Public debt</td>
<td>AMECO</td>
</tr>
<tr>
<td>Real Gross Domestic Product - Greece</td>
<td>AMECO</td>
</tr>
</tbody>
</table>

Notes:
1. For Australia, government final wage consumption is computed as CGW = WSSS − WSSE * EEP, where WSSS is total compensation of employees, WSSE is the compensation rate in the private sector and EEP is dependent employment in the private sector.
2. For Germany, total dependent employment, EE, and dependent employment in the private sector, EEP, are respectively computed from the following relationships: WSST = WSSS / EE and WSSE = (WSSS − GCW) / EEP, where WSST is the compensation rate of the total economy, WSSE is the compensation rate in the private sector, WSSS is total compensation of employees, and GCW is government final wage consumption expenditure. In the case of Germany, the series for WSST and WSSE are given directly in the database and need not to be calculated.
3. For Australia, Austria, Germany and Greece, general government employment is computed as GE = EE − EEP, where EE is total dependent employment and EEP is dependent employment in the private sector.
NOTES ON FIGURES

Figure 1: Greece versus the OECD average (1970-2015).
Annual data over the period 1970-2015. GDP per head is in constant 2010 prices, constant PPPs (in US dollars). OECD average includes all member countries of the OECD. The HP trend is obtained using a smoothing parameter of 100.

Figure 2: The Greek Public debt-to-GDP ratio: Actual vs Counterfactual.
For the counterfactual case, we assume that Greek GDP (in market prices) after 1979 grows at the same rate as the growth rate of the OECD average GDP (in market prices).

Figure 3: State Control Index and Union Density in the Public over the Private Sector.
3a: Median values over the years 1998, 2003, 2008 and 2013. The Index scale for the state control index is 0-6 (from least restrictive (0) to most restrictive (6)).
3b: Ratio of the union density in the public sector to the union density in the private sector; median values over a maximum time span (depending on data availability) 1970-2010.

Figure 7: Public Sector Wage Premium.
Compensation rate in the public sector divided by the compensation rate in the private sector. The standard measure for comparing wages across sectors, is the average compensation rate. OECD defines the compensation rate in a sector as the ratio of the compensation of employees and the number of Employees in that sector. Compensation of Employees is defined as the total remuneration in cash or in kind, payable by enterprises to employees in return for work done by the latter, during the accounting period. It includes wages and salaries and employers’ social security contributions. The number of employees refers to dependent employment and thus excludes the self employed. Median values over the period 1970-2010 for AUS, AUT, BEL, CAN, FIN, FRA, GR, ITA, JPN, NOR, NLD, SP, SWE, UK, US, 1971-2010 for DNK, IRL, 1977-2010 for PRT, and 1991-2010 for GER

Figure 8: Correlations with Public Sector Wage Premium: Greece 1970-2010.
All series with the exception of the real per capita GDP growth rate have been detrended using the Hodrick Prescott filter with a smoothing parameter λ=100.