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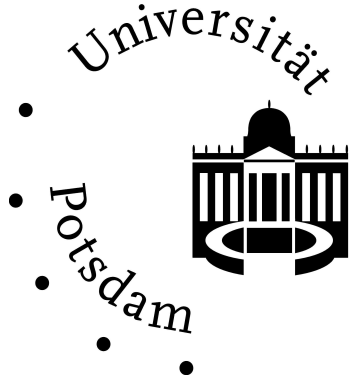
IMPERFECT GOODS AND LABOR MARKETS, REGULATION, AND SPILLOVER EFFECTS



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Imperfect Goods and Labor Markets, Regulation, and Spillover Effects

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Abstract

(De)regulatory interventions frequently have unintended cross-market effects, which may or may not be desirable. We assess the effects of three policies on aggregate variables, in particular real income, from a theoretical perspective. Our results suggest that instruments acting upon wages have only a weak impact on real income, whereas the distribution of income is affected strongly. In contrast, a policy that enhances product market competition is fostering real income, but also impacts strongly on union wages and the distribution of income.

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1 Introduction

Interventions on the labor market impact on the product markets because product prices depend on labor costs. In addition, higher wages may push some firms out of the market. Interventions on the product markets impact on the determination of wages because they affect the attitude of the bargaining parties towards higher wages. The size of the rents that workers and firm owners share, e.g. through wage bargaining, depends upon the degree of competition on the product market (see e.g. Booth, Burda, Calmfors, Checchi, Naylor and Visser, 2000, p. 68). "Therefore, accounting for the potential cross-market effects of product and labor market policies appears to be an important element of good policy design" (Nicoletti, Bassanini, Ernst, Jean, Santiago and Swaim, 2001, p. 7).

In this study, we examine from a theoretical perspective to which extent these and other cross-market effects matter for (de)regulation. For this purpose, we develop a general equilibrium model with monopolistic competition on the product markets and with trade unions bargaining over wages on the labor market. We consider the effects of interventions on either market. The main focus of the analysis lies on the effects on real income and its distribution.

The importance of spillover effects between goods and labor markets for the assessment of regulatory interventions on either market has also been stressed in a number of recent publications by the OECD and related researchers (see e.g. Boeri, Nicoletti and Scarpetta (2000), Nicoletti et al. (2001), OECD (2001), and Jean and Nicoletti (2002)). Another related paper is Blanchard and Giavazzi (2001). One important difference is that we consider a dual labor market, which allows for considering the issue of income distribution between workers who are or are not covered by wage agreements.

The following section develops the theoretical model and derives some analytical results under the assumption of decentralized bargaining. Section 3 derives the results numerically, allowing for more central wage bargains. Section 4 concludes.

2 A simple model of imperfect in- and output markets

Our model economy consists of two sectors. In the monopolistic competitive (heterogeneous) sector n firms produce heterogeneous goods with decreasing average costs. In the perfectly competitive (homogeneous) sector an undetermined number of firms produce a homogeneous good with constant average costs. This setting is motivated by recent empirical work providing evidence for the coexistence of constant- and increasing-returns-to-scale industries (Antweiler and Trefler, 2002).

The market for labor is dual. The competitive secondary labor market provides the natural 'exit option' for workers bargaining over wages in the primary labor market. While firms in the homogeneous sector employ exclusively workers from the secondary labor market, production in the heterogeneous sector requires unionized labor as an input. If there would be wage bargaining in the homogeneous sector, the union wage rate would coincide with the competitive wage rate anyway, because no surplus to be bargained over is generated. Many empirical studies support the assumption of a dual labor market (for a survey see Saint-Paul, 1996).

Each firm in the heterogeneous sector also employs a fixed amount of non-unionized labor. Since the competitive wage rate is determined by the technology of the homogeneous sector, wages paid to these workers have the character of fixed costs. Alternatively and equivalently, the fixed input may be interpreted as the corresponding amount of the homogeneous good. For instance, an agreement between a firm producing cars and a union usually does not cover workers who fulfill functions that have been outsourced like security or cleaning. These costs are fixed, as they do not depend on the amount of cars produced.

Workers

There are N identical workers, indexed by j. The utility of a worker depends on the amount of homogeneous and heterogeneous goods consumed ($x_{0,j}$, and $x_{i,j}$ with $i = 1, 2, \ldots, n$, respectively). The utility function of a representative worker is

$$u_j = u(x_{0,j}, x_{1,j}, \ldots, x_{n,j}) = x_{0,j}^{1-\beta} \cdot X_j^{\beta} \tag{1}$$

with

$$X_j \equiv \left(n^{-(1-\rho)} \sum_{i=1}^{n} {x_{i,j}}^{\rho} \right)^{\frac{1}{\rho}} \quad 0 < \rho < 1$$

where $x_{0,j}$ stands for the homogeneous good, and n gives the number of heterogeneous firms/ goods (Blanchard and Giavazzi, 2001). β is the expenditure share, and X_j a composite index of the latter. The elasticity of substitution between any two heterogeneous goods is $\sigma \equiv 1/(1-\rho) > 1$, and is derived endogenously through the relationship

$$\rho = 1 - \frac{1}{\zeta \cdot n}, \qquad \zeta > 0 \text{ and } \zeta \cdot n = \sigma > 1 \tag{2}$$

(for an alternative formulation see Blanchard and Giavazzi, 2001, p. 6). We interpret ρ as a measure for the intensity of competition. A larger number of firms n thus reinforces competition, expressed by a higher elasticity of substitution. The policy parameter ζ determines how strongly ρ, and thereby σ, depend on the number of firms. This parameter is referred to as 'transparency´ in the following, because only if a market is sufficiently transparent, the number of competitors impacts on the behavior of a consumer.

Apart from ρ being endogenous another difference to the Dixit-Stiglitz framework is the presence of $n^{-(1-\rho)}$ in the definition of the composite index. The effect of this term becomes clear when we assume that consumption of each heterogeneous variety is equal, i.e. $x_{1,j} = x_{2,j} = \ldots = x_j$. In this case, we get $X_j = n \cdot x_j$. Hence, utility depends only on the total amount of consumption. Consumers benefit from a higher number of firms only through the reduction of mark-ups by lower market power. By contrast, in the original Dixit-Stiglitz framework worker experience a direct utility gain from an increase of the number of firms/ varieties.

Maximization of the utility function (1) under a budget constraint yields the demand functions

$$X_j = \frac{\beta y_j}{P} \quad \text{and} \quad x_{0,j} = \frac{(1-\beta) y_j}{p_0} \tag{3}$$

where y_j denotes the income of worker j, p_0 is the price of the homogeneous good and P is the price index of the heterogeneous goods, defined by

$$P = \left(\frac{1}{n} \sum_{i=1}^{n} p_i^{\frac{\rho}{\rho-1}} \right)^{\frac{\rho-1}{\rho}} \tag{4}$$

Income y_j of a worker is either the union wage rate or the competitive wage rate, $y_i \in w, \overline{w}$. By minimizing the expenses for a given value of X_j we obtain the

individual demand function:

$$x_{i,j} = \left(\frac{P}{p_i}\right)^{\frac{\rho}{1-\rho}} \frac{\beta y_j}{n p_i} \tag{5}$$

Hence, the aggregate demand for good x_i is

$$x_i = \left(\frac{P}{p_i}\right)^{\frac{\rho}{1-\rho}} \frac{\beta}{n p_i} Y \tag{6}$$

and depends linearly on the total income of workers $Y \equiv \sum_{j=1}^{N} y_j$.

Firms

Firms in both sectors maximize profits. The homogeneous good x_0 is produced employing exclusively labor from the competitive labor market. The technology is linear (no fixed costs), $x_0 = L_0$. Market entry occurs until firms just break even. The good serves as a numeraire. This implies that the competitive wage rate is unity: $\overline{w} = p_0 \equiv 1$.

Each heterogeneous good is produced by one firm, employing a fixed amount of Δ units of labor from the competitive labor market, and

$$L_i(x_i) = \frac{x_i}{\alpha} \tag{7}$$

units of labor from the unionized labor market, where α is constant and exogenous output per unionized worker. Each firm is sufficiently small that it can ignore the effects of its decisions on aggregate output and employment. Profits π of firm i read

$$\pi_i = x_i \cdot p_i - L_i \cdot w_i - \Delta$$

Substituting L_i by (7) and p_i by the inverse demand function, maximization of π_i yields the optimum price

$$p_i = \frac{w_i}{\alpha\rho} \quad \text{or} \quad p_i = \frac{w_i}{\alpha}\frac{\sigma}{\sigma - 1} \tag{8}$$

The mark-up over marginal costs is a negative function of n, since ρ depends positively on n. Market entry is free and costless. Firms enter/ leave the market until the profits of an additional firm would be negative. In a symmetric equilibrium all firms i are the same ($x_i = x$, $p_i = p$, $L_i = L$, $w_i = w$ and $\pi_i = \pi = 0$).

Trade unions

Each union bargains with a fraction γ of the firms in the unionized sector of the economy over the wage rate w. This implies that the number of unions is $1/\gamma$. Unions maximize the expected utility of a representative worker who is allocated to one of the corresponding firms. Determination of the expected utility requires the probabilities of employment in the unionized and in the competitive labor market. Assuming that workers are distributed evenly across all firms in the heterogeneous sector, the probability of a worker to become employed in the primary labor market is $n \cdot L/N$. All remaining workers supply labor on the secondary labor market.

Expected utility of a worker is

$$U^+ = \frac{nL}{N} u_j(w, P^+) + \left(1 - \frac{nL}{N}\right) u_j(1, P^+)$$

if the union he is attached to and the corresponding firms agree upon a wage, and

$$U^- = u_j(1, P^-)$$

if there is no agreement[1]. P^+ and P^- are the price indices of the heterogeneous goods, respectively in the cases of an agreement and of no agreement. If γ is above 0, the price index differs in the two cases, and this is taken into consideration during the bargain.

Timing of the model

Since our model is static, there is no chronological order of actions and reactions. Nevertheless, by assuming a specific informational status of the workers, firms and unions, we determine what may be called a logical order.

One of the main differences to Blanchard and Giavazzi (2001) is the way market entry is modeled. In their paper, firms face entry costs, which have a similar function as the fixed costs here. But since they are sunk costs, it is difficult to explain why the number of firms should shrink after a marginal deterioration of their still positive profits. Blanchard and Giavazzi (2001, p. 17) argue that "firms which die are not replaced". But it is not clear why firms should die in the model because profits remain strictly positive. In our model all firms that enter the market actually cover

[1]This second term serves only as the 'conflict point' during the bargain, but is never realized, because all agents fare better in the case of an agreement.

the fixed costs. Thus, starting from a zero profits equilibrium, a deterioration of the firms' economic situation leads to losses, which push some firms out of the market. But - as the entry costs in the Blanchard and Giavazzi framework - the fixed costs do not affect wages, if they arise independently of whether or not there is an agreement in the wage bargain.

From these considerations it follows that the ordering of decisions must be: First market entry/ exit decisions are taken. Then fixed costs arise for those firms that are in the market. Wage bargains take place independently of each other. The bargaining parties know the outcome of all other bargains, e.g. through a heuristic process that is terminated in the long-run equilibrium we look at. This assumption allows us to abstract from the strategic interplay between different bargains that otherwise would take place. Once wages are determined, goods are produced, sold and consumed. However, in a long-run equilibrium only firms that can actually cover fixed costs enter the market.

The wage bargain

Both unions and firms take into account the responses of aggregate demand, employment, workers' income, and prices regarding changes of the wage rate. In contrast, they take the number of firms in the heterogeneous sector as given.

We assume that wages are determined through the standard asymmetric Nash solution. The Nash product reads[2]

$$NP = \gamma n[px - Lw] \cdot [U^{+} - U^{-}]^{\delta} \tag{9}$$

where δ denotes the relative bargaining power of the union (Nickell, 1999, p. 3), a policy parameter. The maximization is constrained by: the demand function (6), the technology of the firm (7), the optimum price of the good (8), the definition of the price index (4), and the composition of the total income.

From a union's and the corresponding γn firms' viewpoint, the price index depends on the result of the bargain because the goods prices depend on the wage rate and the number of firms is not negligible relative to the aggregate economy. If we

[2]As noted earlier, wages, demand, labor input etc. are the same for all firms in a symmetric equilibrium. Nevertheless, the bargaining parties consider these variables to depend on the result of the bargain if they are related to them, and as exogenous if they are related to other firms/ workers. Therefore, it is not correct to omit the index in the following equations. Nonetheless, we skip it for the ease of the representation.

differentiate between firms that are covered and firms that are not covered (in the latter case p_i, L_i and w_i carry a bar, symbolizing that these values are given to the bargaining parties), definition (4) becomes

$$P = \left[\frac{1}{n}\left(\sum_{i=1}^{\gamma n} p_i^{\frac{\rho}{\rho-1}} + \sum_{i=\gamma n+1}^{n} \overline{p_i}^{\frac{\rho}{\rho-1}}\right)\right]^{\frac{\rho-1}{\rho}} \tag{10}$$

Total income from the viewpoint of the bargaining parties is

$$\begin{aligned} Y &= \sum_{j=1}^{\gamma N}\left[\frac{nL_i}{N}w_i + \left(1 - \frac{nL_i}{N}\right)\right] + \sum_{j=\gamma N}^{N}\left[\frac{n\overline{L_i}}{N}\overline{w_i} + \left(1 - \frac{n\overline{L_i}}{N}\right)\right] \\ &= \sum_{j=1}^{\gamma N}\left[\frac{nL_i}{N}(w_i - 1)\right] + \sum_{j=\gamma N}^{N}\left[\frac{n\overline{L_i}}{N}(\overline{w_i} - 1)\right] + N \end{aligned} \tag{11}$$

The resulting wage rate is not amenable to a formal representation in general. Only in the benchmark case of decentralized bargaining ($\gamma \to 0$) a closed form can be found, which is

$$w_i|_{\gamma\to 0} = \frac{\delta + \rho}{\rho(1+\delta)} \tag{12}$$

This solution applies in section 3. In the more general case of a positive degree of centralization, the wage rate can only be derived numerically, which is done in section 4. Fully determining the wage rate requires calculating the number of firms n, because ρ depends on n. Other variables that are derived at the macro level are the price index of the heterogeneous goods P and total income Y.

The macro level

To be able to aggregate the variables that are determined at the level of the bargain, we impose symmetry. In a symmetric equilibrium, (4) becomes

$$P = p_1 = p_2 = \ldots = p$$

The cost-of-living price index $\hat{P}$, needed to calculate real income, can be derived by a weighting of the prices in both sectors with the respective expenditure shares:

$$\hat{P} = P^{\beta} \cdot 1^{1-\beta} = p^{\beta} \tag{13}$$

Aggregate income (11) becomes

$$Y = nL(w - 1) + N \tag{14}$$

As in the Dixit-Stiglitz framework the number of heterogeneous firms/ goods is determined through the assumption that the firms' profits are zero in equilibrium. Since there are fixed costs, this does not imply a breakdown of the wage bargains because of absent rents. In comparison with Blanchard and Giavazzi (2001), a small deterioration of the firms' situation leads unambiguously to a decrease of the number of firms. Setting $\pi_i = x_i p_i - L_i w_i - \Delta = 0$, making use of $L_i = x_i/\alpha$ (equation (7)) and $w_i = \alpha\rho p_i$ (equation (8)), we get $(1-\rho)p_i x_i - \Delta = 0$. In a symmetric equilibrium ($P = p_i$), market demand writes $x_i = \beta Y/(np_i)$ (equation (6)), and from the definition of ρ (equation (2)),we know that $1 - \rho = 1/(\zeta n)$. Employing this information, the zero-profits condition yields:

$$n = \sqrt{\frac{\beta Y}{\Delta \zeta}} \tag{15}$$

The three equations for the price index P, total income Y and the number of firms n determine - together with the results and definitions that we derived before - the simultaneous long-run equilibrium. The following variables are endogenous: the wage rate w, variable employment per firm L, the product price p, demand for each variety x, number of firms n, the total income Y, the price index P and the elasticity of substitution σ. The endogenous variables depend on the number of workers N, the expenditure share of the heterogeneous goods β, output per unionized worker α, the fixed labor input Δ, and three policy parameters: δ, γ and ζ. The latter are discussed in somewhat more detail in the following paragraph.

Regulation of labor and goods markets

The basic theoretical model described in the previous paragraphs contains three different policy parameters: One which is related to the goods market, and two labor market related parameters.

The former is named ζ and impacts on the responsiveness of the elasticity of substitution between any two varieties, σ, with respect to market entry. How can economic policy influence the effect of market entry on the elasticity of substitution? One possible interpretation is that it represents market transparency, which can be influenced by laws binding firms on published prices or forcing firms to comply with specific norms (e.g. DIN or ISO standards). Although this is only a terminological difference, it should be noted that that interpretation is rather the inverse of the one Blanchard and Giavazzi (p. 10 and 17) have in mind for their related parameter $\overline{\sigma}$,

where increases of the parameter are named "product market deregulation". In our interpretation transparency and competition are enhanced rather than worsened by regulatory measures. However, in order to avoid confusion we refer to this parameter as "product market transparency" in the following.

The two union related policy parameters are quite clear without ambiguity. First, the role of the degree of centralization of the wage bargain, γ, has been discussed in many contributions since the seminal paper of Calmfors and Driffill (1988), including the case of monopolistic competition (for a short summary of this literature see Booth et al., 2000, p. 120ff.). If γ is small, the effect of a bargain's outcome on the aggregated variables is negligible. This case is usually referred to as *decentralized bargaining*, and is commonly regarded as the standard in bargaining theory, although many European countries are characterized by higher degrees of centralization. Yet, the US and Canada, where bargaining at the firm level prevails, are quite close to this ideal. Governments influence γ through extension clauses etc. In the model, centralization of the bargain brings about the (partial) internalization of the disadvantageous effect higher wages have on the price level, as in the Calmfors-Driffill framework. In addition, higher wages also have an advantageous general equilibrium effect by increasing income, demand and employment in the heterogeneous sector. Since γ causes much of the model's complexity, we set this parameter to zero in the following section for convenience.

Second, δ symbolizes the relative bargaining power of trade unions. If this parameter is zero, wages are competitive. The case $\delta \to \infty$ means that the union can set wages unilaterally (monopoly union). Pencavel (2002, p. 15ff.) depicts among other things how the Thatcher administration depressed union power in Britain. Examples of measures include the legislation on strikes, lock-outs, union governance and the closed shop. The consideration of two different labor market related policy parameters is motivated by the fundamentally different way these two parameters impact on the endogenous variables. However, they are not independent of each other. For instance, a higher degree of centralization of the bargain may influence the desirability of higher wages for unions. Yet, how strong this affects the wage rate still depends on their bargaining power.

3 Decentralized bargaining: A benchmark case

In this section we derive analytically how variations of ζ (product market transparency) and δ (union bargaining power) affect the equilibrium values of some selected variables. We assume decentralized bargaining ($\gamma \to 0$), which is the standard in the bargaining literature. First we derive the equilibrium. Then we calculate the responses of the endogenous variables to variations of the policy parameters ζ and δ. In doing so, we focus on the union wage rate, and on the variables that are determined at the macro-level, i.e. aggregate income Y, the price index P, the number of firms n, and, derived from the latter, the degree of competition, represented by ρ.

3.1 Equilibrium

In a symmetric equilibrium with decentralized bargaining, many analytical expressions simplify considerably. In particular, the wage rate equals (12), which still contains the endogenous ρ, however. In order to keep the results simple and manageable, we do not substitute all endogenous variables. Instead, we try to display all results as compact as possible. ρ is given by (2) and n by (15). The heterogeneous goods' price-index equals the price of one variety in a symmetric equilibrium, $P = p_i$. Making use of (8) and inserting the wage rate (12), we get

$$P = \frac{\delta + \rho}{\alpha \rho^2 (1 + \delta)} \tag{16}$$

Aggregate nominal income is given by (14). Employing (12) and some of the previous results,

$$Y = \frac{N(\delta + \rho)}{\delta + \rho - \beta\delta\rho(1 - \rho)} \tag{17}$$

obtains. (16), (17) and the equations we referred to suffice to describe the symmetric equilibrium. It is possible to verify the correctness of the results by means of the redundant equilibrium condition of the homogeneous goods market: $x_0^{demand} = (1 - \beta)Y = N - n(L_i + \Delta) = x_0^{supply}$.

3.2 The effects of goods and labor market regulation

The policy parameters have direct and indirect effects on the endogenous variables. In abbreviated form, the functional relationships are:

$$P = P(\rho, \delta);\ Y = Y(\rho, \delta);\ n = n(Y, \zeta);\ \rho = \rho(\zeta, n);\ \text{and}\ w = w(\delta, \rho) \tag{18}$$

For instance, to calculate the total effect of an increase of the union bargaining power δ on aggregate income Y, we have to take into account the direct effect of δ on Y, which is given by the partial derivative, and the effect of δ on the degree of competition, ρ, which also impacts on Y. In order to derive the total effects of variations in ζ and δ, we first evaluate the partial derivatives of w, P, Y, n and ρ with respect to the endogenous variables and the policy parameters. These partial derivatives are given in the appendix. Furthermore, we define:

Definition 1
Competition on the goods market is *intense* if $-\rho^2 + \delta(1 - 2\rho) < 0$, and is *feeble* otherwise. This implies that, if $\rho > 0.5$, competition is always intense, and if $\rho \to 0$, competition is feeble.

It should be noted that *intense* competition is the more likely case, since, for competition to be *feeble*, ρ must be considerably below 1/2, which corresponds to a price-elasticity of demand[3] below 2.

Employing this definition and the partial derivatives given in the appendix, we derive the following results for the case of decentralized bargaining:

Proposition 1
Aggregate nominal income depends positively on the union bargaining power. The number of firms depends positively on the union bargaining power and negatively on product market transparency. Iff competition on the goods market is intense, aggregate nominal income also depends negatively on product market transparency.
Proof: Employing the functional relationships summarized in (18), the total derivative of Y with respect to δ can be expressed as[4]

$$\frac{dY}{d\delta} = \frac{\frac{\partial Y}{\partial \delta}}{1 - \frac{\partial Y}{\partial \rho}\frac{\partial \rho}{\partial n}\frac{\partial n}{\partial Y}} \tag{19}$$

[3]With the assumed utility function (1), the price-elasticity of demand equals the elasticity of substitution between two varieties, $\sigma = 1/(1 - \rho)$.

[4]In the following, we denote the partial derivative of a variable a with respect to b by $\partial a/\partial b$, and the respective total derivative by da/db.

Substitution of the partial derivatives given in the appendix and some transformations yield

$$\begin{aligned}\frac{dY}{d\delta} &= \frac{2N\beta\rho^2(\delta+\rho)(1-\rho)}{2\delta^2(1-\beta\rho)+\delta\rho(4-\beta)+\rho^2(2+\beta\delta+2\beta\delta^2)+\rho^3\beta(1-\rho)} \\ &\quad \cdot\frac{1}{\delta[1-\beta\rho(1-\rho)]+\rho} > 0\end{aligned}$$

The terms have been rearranged such that the expression within every bracket has a strictly positive sign, so that the total effect is clearly positive. The total derivative of Y with respect to ζ is

$$\frac{dY}{d\zeta} = \frac{\frac{\partial Y}{\partial \rho}\left(\frac{\partial \rho}{\partial \zeta}+\frac{\partial \rho}{\partial n}\frac{\partial n}{\partial \zeta}\right)}{1-\frac{\partial Y}{\partial \rho}\frac{\partial \rho}{\partial n}\frac{\partial n}{\partial Y}} \tag{20}$$

The denominator of this derivative is the same as in (19), and positive without ambiguity. The sign of the nominator seems to be ambiguous, because the two terms in the bracket have inverse signs. Economically this stems from the fact that more transparent product markets lead to more intense competition among existing firms, which decreases wages and income, whereas the induced decrease of the number of firms has the opposite effect on competition and income. Yet, if we substitute the partial derivatives given in the appendix, the bracketed terms become $1/(2n\zeta^2)$, which is clearly positive. If competition is intense, $\partial Y/\partial \rho$ is negative (equation 21 in the appendix). Hence the total derivative has a negative sign.

The total effect of a change in the union bargaining power on the number of firms follow as a corollary from the effect on income. It can be expressed as

$$\frac{dn}{d\delta} = \frac{\partial n}{\partial Y}\frac{dY}{d\delta} > 0$$

The direction of the effect is unambiguous and yields from the signs of the total derivative of Y and the partial derivative given in the appendix. The total derivative with respect to market transparency is

$$\frac{dn}{d\zeta} = \frac{\partial n}{\partial \zeta} + \frac{\partial n}{\partial Y}\frac{dY}{d\zeta}$$

After substituting the partial derivatives given in the appendix and the total derivative of Y, the expression becomes

$$\begin{aligned}\frac{dn}{d\zeta} &= -\frac{\{[1-\beta\rho(1-\rho)]\delta^2+\delta\rho(2-\beta)+\rho^2+\beta\delta\rho^2(2-\rho)+\beta\rho^3(1-\rho)\}}{2\delta^2(1-\beta\rho)+\beta\delta\rho^2(1+2\delta)+\beta\rho^3(1-\rho)+\delta\rho(4-\beta)+2\rho^2} \\ &\quad \cdot n^2(1-\rho) < 0\end{aligned}$$

Again, the terms have been grouped such that the expression within every bracket is strictly positive. Accordingly, the entire derivative is negative. This result is independent of whether competition on the products market is intense or not. ■

If competition is feeble ($\rho \to 0$), however, the partial derivative $\partial Y/\partial \rho$ has a positive sign. Economically, this is caused by the following trade-off: On the one hand more competitive product markets decrease the prices of the products, which increases demand and, thereby, augments employment and total income. On the other hand, wages decrease through the reduction of rents, which impacts negatively on total income. If competition is feeble, the former effect prevails. In this case, the total effect of more transparent product markets on nominal income is positive. Yet, the result given in proposition 1 can be expected to hold in most cases, because of the narrow scope for feeble competition.

Proposition 2

Competition is reinforced by increases of both union bargaining power and product market transparency.

Proof: The degree of competition is measured by ρ, which depends directly on transparency, ζ, and on the number of firms, n. Therefore, employing proposition 1 and the partial derivatives given in the appendix, the effect of an increase of the relative union bargaining power, δ, obtains as the total derivative

$$\frac{d\rho}{d\delta} = \frac{\partial \rho}{\partial n}\frac{dn}{d\delta} > 0$$

The total derivative of ρ with respect to transparency, ζ, is

$$\frac{d\rho}{d\zeta} = \frac{\frac{\partial \rho}{\partial \zeta} + \frac{\partial \rho}{\partial n}\frac{\partial n}{\partial \zeta}}{1 - \frac{\partial \rho}{\partial n}\frac{\partial n}{\partial Y}\frac{\partial Y}{\partial \rho}}$$

Substitution of the partial derivatives given in the appendix and rearranging yields

$$\frac{d\rho}{d\zeta} = \frac{(1-\rho)\{[\delta + \rho - \beta\delta\rho(1-\rho)]2(\delta+\rho)\}}{2\zeta\left[2\delta^2(1-\beta\rho) + \delta\rho(4-\beta) + 2\rho^2 + \beta\delta\rho^2 + 2\beta\delta^2\rho^2 + \beta\rho^3(1-\rho)\right]} > 0$$

Since the content of each bracket is positive, it the whole expression is positive, too. Both results do not hinge on the degree of competition. ■

The result concerning variations of market transparency is to be expected, whereas it may be surprising that stronger unions increase competition among firms in the model. The reason is that stronger unions increase total nominal income, which has a positive effect on the number of firms.

Proposition 3

The union wage rate and the price-index of the heterogeneous goods depend positively on the union bargaining power and negatively on product market transparency.

Proof: See the appendix.

From the definition of the price-index it follows that the effects on the price for each heterogeneous variety, p_i, and for the cost-of-living price index $\hat{P}$ have the same direction as those on P. Since both, the cost-of-living price index, and the total nominal income depend positively on the bargaining power of the unions, and negatively on product market transparency, it is interesting to see, which effect on real income prevails.

Proposition 4

Total real income depends negatively on the bargaining power of the unions and depends positively on product market transparency.

Proof: See the appendix.

The latter results are unambiguous. In particular, they do not hinge on the degree of competition. It should be noted that the result does not imply that all workers fare worse with stronger unions. Real income of a primary-sector worker increases due to an increase of the bargaining power of the corresponding union. But real income of a secondary-sector employed clearly falls, since his nominal income remains the same, while the price-index rises. The inverse reasoning applies for the effects of an increase of product market transparency.

Proposition 4 is particularly interesting, because real income is the natural target of governmental interventions in the model. It suggests that a government that grasps at increasing real income should impair unions and foster market transparency. In the model, such a combined policy would have a number of side-effects, however. Most importantly, both measures impact negatively on the number of firms in the heterogeneous sector of the economy. Nominal income, wages, and prices would decrease. The effect on competition is indetermined, since the decrease of union power impacts negatively, and the increase of transparency impacts positively on it.

Proposition 4 implies that unions disregard the negative impact of wage increases on the price-level, which harms workers who are not covered by the bargain. In the model, the extent to which unions take this effect into account can be varied by

the policy parameter γ, the degree of centralization of the bargain. This parameter has been set to zero in this section, because otherwise the total effects of variations in δ and ζ couldn't have been derived analytically. The numerical analysis in the following section aims at generalizing our analytical results by allowing for a higher degree of centralization. Furthermore, γ itself is considered a policy parameter. Finally, a quantitative comparison between the prevailing effects may contribute to a classification of the policy instruments regarding their adequateness.

4 Calibration

The primary goal of this section is to examine whether or not the results of the previous section hold if the wage bargains concern a non-negligible part of the workforce. Furthermore, we analyze how variations of the degree of centralization itself impact on wages, prices, income, competition and number of firms. Substituting the exogenous parameters by numbers simplifies the model strongly, so that it allows for the additional complexity coming along with non-decentralized bargaining. The disadvantage of numerical methods is generally that the results only apply to specific cases. A sensitivity analysis can mitigate this disadvantage by verifying the results for different settings. Even so, we abstain from a sensitivity analysis, because the outcome coincides with the analytical results, and all occurring effects can be traced back to plausible interactions within the model.

The following equations are employed to evaluate the equilibrium numerically: The Nash-product (9) to be maximized and the indicated constraints of the optimization; the definition of ρ, equation (2); the zero-profits condition (15); total nominal income (14); the heterogeneous goods' optimal price (8), which coincides with the price- index P; demand for each heterogeneous variety (5), and the labor input requirement $L_i = x_i/\alpha$.

Next, we introduce the parameter values employed in the calibration, and present the numerical results.

4.1 Parameter values

For simplicity, we set the number of firms, N, and variable output per worker, α, to unity. The former allows to interpret the number of workers working in the

primary and the secondary sector also as the corresponding relative share. The other parameter describing the technology, Δ, is assumed to be 0.002. Admittedly, there is no rationale for this specific value. But it fulfills the requirements to be positive, which brings about decreasing average costs in the heterogeneous sector, and small, which allows for a large number of monopolistically competitive firms. The expenditure share of the heterogeneous sector, β, is 1/2. This intermediate value permits to vary other parameters strongly, without obtaining a corner solution. In a recent contribution, Antweiler and Trefler (2002) estimated that at least a third of all goods-producing industries is characterized by constant and by increasing returns to scale. For the remaining industries no inferences about scale could be made. Antweiler and Trefler (2002, p. 112) conclude that their "results point to the importance of integrating constant- and increasing-returns-to-scale industries within a single general-equilibrium framework."

Since we examine variations of the policy parameters δ, γ and ζ, each of them has more than one single value. On the contrary, we chose rather wide scales. Union bargaining power, δ goes from 0.2 to 2, where the intermediate value 1 implies symmetric bargaining, which is assumed when one of the other policy parameters is varied. The degree of centralization, γ, runs from 0.0001 to 0.5. At the upper bound of this scale the union wage rate approaches the competitive wage rate, and then remains nearly constant. In the cases, where variations of the other parameters are examined, γ has the intermediate value 0.2. Product market transparency, ζ, runs from 0.1 to 1.5. It amounts to 0.2 when the effects of other policy parameters are considered. Table 1 summarizes all parameter values assumed.

Parameter	α	β	γ	δ	Δ	N	ζ
Value	1	0.5	0.2^*	1^*	0.002	1	0.2^*

* Policy parameters that have different values when their own effects are under consideration.

Table 1: Assigned parameter values

4.2 The effects of goods and labor market regulation

Figure 1 depicts the course of some characteristic endogenous variables in response to variations of respectively one policy parameter. We consider the effects on the wage rate w, total nominal income Y, total real income $Yreal$, the price of a heterogeneous variety p, the measure for the degree of competition in the heterogeneous sector

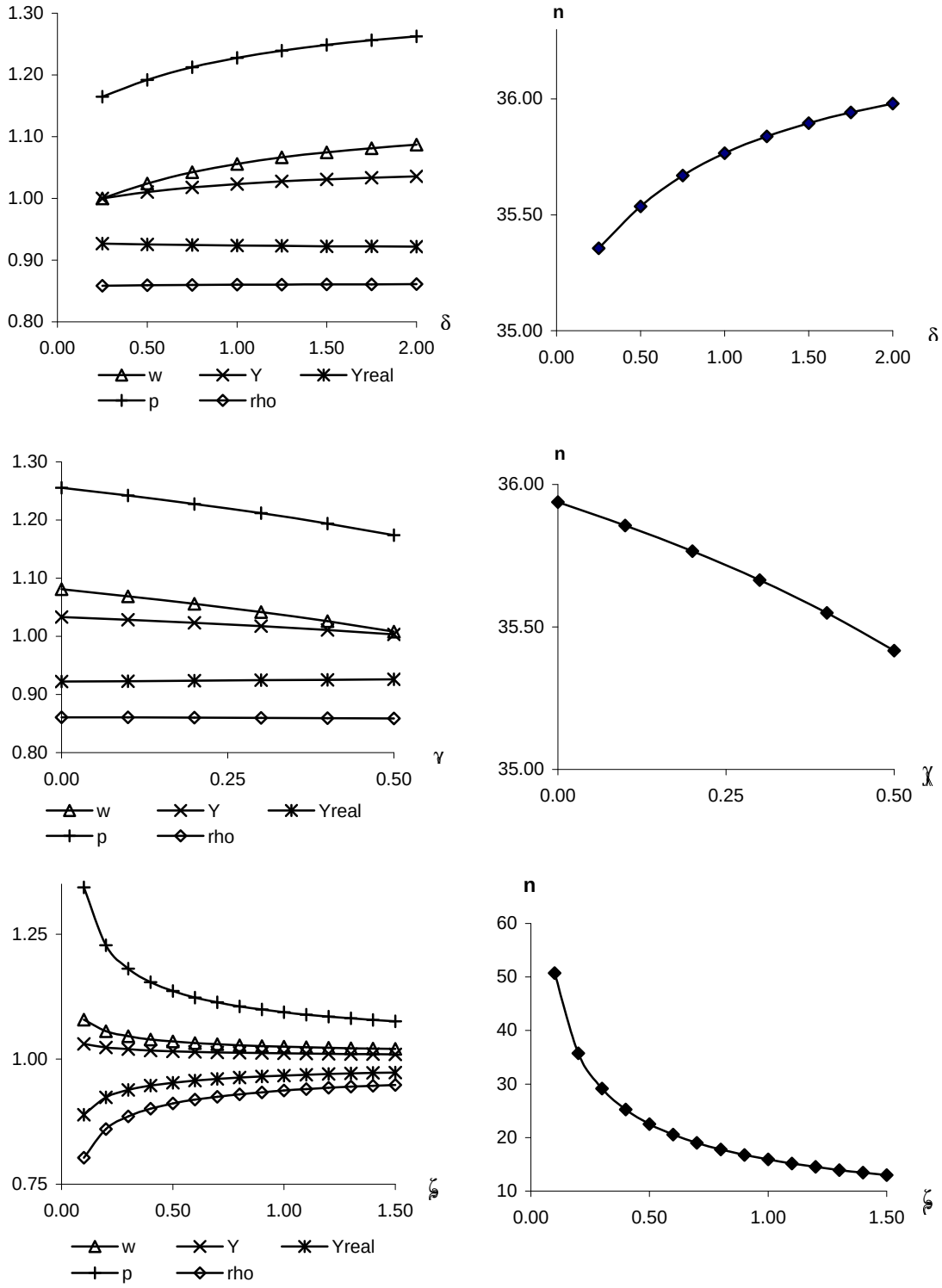

Figure 1: Numerical results

ρ, and the number of firms n. The effects on the latter variable are shown in separate coordinate systems at the right-hand side. The two coordinate systems at the top graph the effects of variations in the union bargaining power, δ. The two parts in the center show how the degree of centralization, γ, affects the endogenous

variables. Finally, the two parts at the bottom depict the influence of product market transparency ζ.

The most important result of the calibration is that our analytical results concerning the effects of the policy parameters δ and ζ are confirmed by the calibration of the model without any qualification. Stronger unions increase nominal wages, prices, and total income, whereas total real income decreases with relative union strength. The number of firms and, therefore, the degree of competition are enhanced by stronger unions. Unlike the analytical analysis, the numerical solution renders possible to qualify the longitude of the effects, at least for the specifications employed. Taking into account that the variations of δ amount from 20% to 200% of its standard value, the positive effects on the number of firms and competition, as well as the detrimental effects on total real income are almost negligible: ρ rises from 0.859 to 0.861 and n from 35.36 to 35.98. Total real income falls from 0.927 to 0.922. In comparison, the union wage rate increases from 1.000 to 1.087 (8.7% more than workers in the secondary labor market earn). Given these results, the conclusion obtains that unions have neither a positive nor a detrimental effect on the aggregated variables in the model, but have a considerable effect on the distribution of income between workers.

Variations of product market transparency, ζ, from 0.1 to 1.5 have the following effects: Competition increases significantly, from 0.803 to 0.949, which lowers prices from 1.344 to 1.076 and rises real income from 0.889 to 0.973. In comparison, the negative effect on the union wage rate, which falls from 1.079 to 1.020, is weaker, so that also workers of the primary labor market profit from an increase of transparency in real terms. The effect on the wage rate is yet considerable. The number of firms in the heterogeneous sector decreases sharply from 50.750 to 12.971. Even though the variation of ζ is extreme, too, the judgement that this parameter is much more effective than a policy that impacts on the relative union power seems appropriate. This judgement is also based on the appraisal that relatively low values of ζ are more realistic. For $\zeta = 0.4$, the corresponding value of ρ is not less than 0.901, which means that the elasticity of substitution between two heterogeneous goods is 10.087. Lower values of ζ, which cause a lower elasticity of substitution, thus seem to be more life-like. In this range, the effects of variations in ζ are the strongest.

An increase of the degree of centralization of the bargains from 0.0001 to 0.5 causes the nominal wage to decrease from 1.081 to 1.008. This provokes a decline

of the total nominal income from 1.033 to 1.003, and a decline of the heterogeneous goods' price from 1.255 to 1.174. Real income increases from 0.922 to 0.926. The number of firms shrinks slightly from 35.938 to 35.417, which causes the measure for the degree of competition, ρ, to decrease from 0.861 to 0.859. The forces driving the described results are well known in the literature (see e.g. Booth et al., 2000, p. 120ff.). More central negotiations cause unions to take into account the effect a higher wage has on the aggregated variables, in particular the price level. Since this effect is considered as detrimental, unions are willing to agree upon lower wages, which causes all other effects.

Although the numerical analysis confirms the analytical results without any qualification, some alterations of the suggestions for a policy to foster real income seem advisable. Both policy instruments that are related to the labor market have only a weak impact on real income. Neither the degree of centralization of the bargains nor the bargaining power of unions prove suitable measures to enhance real income. Increasing the bargaining level and decreasing the power of unions has important implications for the distribution of income within an economy, but does not enhance real income significantly. On the contrary, an amelioration of product market transparency, be it called 'regulation' or 'deregulation', improves real income considerably by enhancing competition. We conclude that a policy measure targeting at the origin of rents is more effective than measures that impact on the distribution of these rents. This result is due to the fact that the intentions pursued with a policy that impacts on wages are foiled to a large extent by the induced effects on prices.

It should be emphasized that our results are somewhat at odds with the initial assertion that an understanding of labor and products market spillover effects is important for a good policy design. The importance of these cross-market effects has been highlighted in a number of recent publications like Boeri et al. (2000), Nicoletti et al. (2001), and OECD (2001). However, in the model regulatory or deregulatory measures that target at the labor market, like extension clauses or the weakening of unions, have only a small impact on the number of firms, competition, and total real income. By contrast, a policy that enhances competition on the products market through an increase of transparency decreases prices strongly and increases thus real income, but has also a considerable impact on wages and nominal prices. Although the numerical results are - strictly speaking - only valid for the specific parameter values employed, they are suggestive, because the specifications are fairly standard and confirm our analytical results.

5 Conclusion

In this contribution we developed a general equilibrium framework to examine the direct and cross-market effects of selected (de)regulatory policy parameters. ´Product market transparency‘ is related to the products market, whereas ´union bargaining power‘ and ´centralization of the bargains‘ target at the determination of wages. The former has a strong negative effect on the formation of rents by enhancing competition. This causes nominal wages, prices and the number of firms to decline, whereas real income increases.

Union bargaining power impacts positively on nominal wages and income, but negatively on total real income. It has a positive effect on the number of firms and the degree of competition. By contrast, more centralized bargains decrease nominal wages and income, but increases total real income. The number of firms decreases and competition is weakened. It is interesting that, in spite of their very unequal effects, increases of both parameters could be labeled 'more regulation' with good reasons[5].

One important insight provided by the calibration is that the two labor market related instruments are not effective regarding total real income, the number of firms, and competition, notwithstanding their impact on the distribution of income. In comparison, a policy that reinforces competition on the products market also has a considerable effect on wages by reducing the rents that are shared through wage bargaining. Therefore, the initial assertion, that a consideration of labor and product market spillover effects is essential for a good policy design, has to be modified: Our model suggests that the distribution of income is determined largely by parameters belonging to the labor market, while real income itself depends more on the conditions of the product markets. Strictly speaking, these results are only valid for the specified functions and parameters. However, since these are supported by our analytical results, we consider them to be exemplary.

[5]See Boeri et al. (2000) for a definition of regulation.

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Appendix A: Partial derivatives

The wage rate is given by (12) and reads

$$w = \frac{\delta + \rho}{\rho(1+\delta)}$$

Its partial derivatives with respect to δ and ρ are:

$$\frac{\partial w}{\partial \delta} = \frac{1-\rho}{\rho(1+\delta)^2} > 0 \quad \text{and} \quad \frac{\partial w}{\partial \rho} = \frac{-\delta}{\rho^2(1+\delta)} < 0$$

The price index for the heterogeneous goods equals the optimal price of one variety (8):

$$P = p = \frac{w}{\alpha\rho} = \frac{\delta + \rho}{\alpha\rho^2(1+\delta)}$$

Its partial derivatives are

$$\frac{\partial P}{\partial \delta} = \frac{1-\rho}{\alpha\rho^2(1+\delta)^2} > 0 \quad \text{and} \quad \frac{\partial P}{\partial \rho} = \frac{-\rho - 2\delta}{\alpha\rho^3(1+\delta)} < 0$$

Aggregate nominal income can be expressed as

$$Y = \frac{N(\delta + \rho)}{\delta + \rho - \beta\delta\rho(1-\rho)}$$

and its partial derivatives read

$$\frac{\partial Y}{\partial \delta} = \frac{N\beta\rho^2(1-\rho)}{[\delta + \rho - \beta\delta\rho(1-\rho)]^2} > 0 \quad \text{and} \quad \frac{\partial Y}{\partial \rho} = \frac{N\beta\rho[-\rho^2 + \delta(1-2\rho)]}{[\delta + \rho - \beta\delta\rho(1-\rho)]^2} \tag{21}$$

The sign of the latter derivative depends on the sign of $-\rho^2 + \delta(1-2\rho)$, which is ambiguous in general. It is negative, if competition is intense (see definition 1).

The number of heterogeneous firms is

$$n = \sqrt{\frac{\beta Y}{\Delta\zeta}}$$

which yields the partial derivatives

$$\frac{\partial n}{\partial Y} = \frac{n}{2Y} > 0 \quad \text{and} \quad \frac{\partial n}{\partial \zeta} = \frac{-n}{2\zeta} < 0$$

The degree of competition is measured by ρ, defined as

$$\rho = 1 - \frac{1}{\zeta n}$$

(see equation (2)). Its partial derivatives are respectively

$$\frac{\partial \rho}{\partial n} = \frac{1}{\zeta n^2} > 0 \quad \text{and} \quad \frac{\partial \rho}{\partial \zeta} = \frac{1}{\zeta^2 n} > 0$$

Appendix B: Proof of proposition 3

The signs of the total derivatives of ρ and P with respect to product market transparency, ζ, follow directly from the results of proposition 2 and the partial derivatives with respect to ρ:

$$\frac{dw}{d\zeta} = \frac{\partial w}{\partial \rho}\frac{d\rho}{d\zeta} < 0$$

and

$$\frac{dP}{d\zeta} = \frac{\partial P}{\partial \rho}\frac{d\rho}{d\zeta} < 0$$

Deriving the direction of the impact of more powerful unions on the nominal union wage rate and the price-index requires a closer look because there are respectively two opposite effects:

$$\frac{dw}{d\delta} = \frac{\partial w}{\partial \delta} + \frac{\partial w}{\partial \rho}\frac{d\rho}{d\delta}$$

and

$$\frac{dP}{d\delta} = \frac{\partial P}{\partial \delta} + \frac{\partial P}{\partial \rho}\frac{d\rho}{d\delta}$$

Substitution of the partial derivatives and some transformations yield

$$\frac{dw}{d\delta} = \frac{\beta\rho^3(1-\rho) + 2\rho^2 + 2\beta\delta\rho^2 + 2\delta\rho(2-\beta) + \delta^2[2-3\beta\rho(1-\rho)]}{2\delta^2(1-\beta\rho) + \delta\rho(4-\beta) + 2\rho^2 + \beta\delta\rho^2 + 2\beta\delta^2\rho^2 + \beta\rho^3(1-\rho)}\frac{1-\rho}{\rho(1+\delta)^2} > 0$$

and

$$\begin{aligned}\frac{dP}{d\delta} &= \frac{2\delta^2[1-2\beta\rho(1-\rho)] + \delta\rho(4-3\beta) + \rho^2(2-\beta) + 2\beta\delta\rho^2 + \beta\rho^3(2-\rho) + \beta\delta\rho^3}{2\delta^2(1-\beta\rho) + \delta\rho(4-\beta) + 2\rho^2 + \beta\delta\rho^2 + 2\beta\delta^2\rho^2 + \beta\rho^3(1-\rho)} \\ &\quad \cdot\frac{1-\rho}{\alpha\rho^2(1+\delta)^2} > 0\end{aligned}$$

The terms have been arranged such that the content of each bracket is strictly positive (note that $\rho(1-\rho) \leq 1/4$, since $0 < \rho < 1$). ■

Appendix C: Proof of proposition 4

Total real income is defined as total nominal income, Y, deflated by the cost-of-living price index $\hat{P}$. Considering (13), the total derivative of the real income with respect to union bargaining power, δ is

$$\frac{d\frac{Y}{\hat{P}}}{d\delta} = \frac{\frac{dY}{d\delta}\hat{P} - Y\frac{d\hat{P}}{d\delta}}{\hat{P}^2} = \frac{1}{\hat{P}}\cdot\left(\frac{dY}{d\delta} - \frac{Y\beta}{P}\frac{dP}{d\delta}\right)$$

Inserting some previous results and simplifying gives

$$\begin{aligned}\frac{d\frac{Y}{\hat{P}}}{d\delta} &= -\frac{2\delta^2(1-\beta\rho) + 2\delta^2\rho(1-\beta) + \delta\rho(4-3\beta) + \rho^2(2-\beta)(1+\delta) + \beta\rho^3}{2\delta^2[1-\beta\rho(1-\rho)] + \delta\rho(4-\beta) + \beta\delta\rho^2 + 2\rho^2 + \beta\rho^3(1-\rho)} \\ &\quad \cdot\frac{\beta Y(1-\rho)^2}{(1+\delta)(\rho+\delta)}\cdot\frac{1}{\hat{P}} < 0\end{aligned}$$

An analogous proceeding yields

$$\begin{aligned}\frac{d\frac{Y}{\hat{P}}}{d\zeta} &= \frac{\frac{dY}{d\zeta}\hat{P} - Y\frac{d\hat{P}}{d\zeta}}{\hat{P}^2} = \frac{1}{\hat{P}} \cdot \left(\frac{dY}{d\zeta} - \frac{Y\beta}{P}\frac{dP}{d\zeta}\right) \\ &= \frac{2\delta^2[(1-\beta\rho(1-\rho)] + \delta\rho[\rho(1-\beta) + (3-2\rho^2) + \beta\rho^2] + \rho^2(1-\rho^2)}{2\delta^2[1-\beta\rho(1-\rho)] + \delta\rho(4-\beta) + \beta\delta\rho^2 + 2\rho^2 + \beta\rho^3(1-\rho)} \\ &\quad \cdot \frac{\beta Y(1-\rho)}{\rho\zeta} \cdot \frac{1}{\hat{P}} > 0\end{aligned}$$

Since the expressions have been arranged such that the content of each single bracket is positive, the signs of the total derivatives can easily be verified. ■

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