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Institutions, Trade and the Political Economy of Financial Development

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ABSTRACT
To study how financial development depends on trade openness and different types of institutions, we present a political economy model in which the elite can repress the financial market at some cost. The elite can persuade the government to set an interest rate ceiling, and it can then channel all capital supplied toward itself. It can thereby keep its capital costs low and limit the domestic production of modern goods by ensuring that ordinary citizens cannot get sufficient capital to produce these goods. The latter raises the prices of modern goods under autarky, but not under free trade. For most world market prices, greater trade openness therefore reduces the elite's incentive to repress the financial market and increases financial development. Better property rights institutions make financial repression more costly for the elite and tend therefore to increase financial development. Better contracting institutions lower the costs of financial transactions, which has countervailing effects on equilibrium financial development. These predictions are consistent with the empirical evidence.

KEY WORDS
Financial development; financial repression; institutions; international trade; political economics.

JEL CLASSIFICATION
D73, F1, G1, G18, O16.

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1 Introduction

Many countries remain financially underdeveloped even though financial development seems to matter for economic growth (Levine, 2005). The question therefore arises why efficient financial markets develop in some countries, but not in others. There are two main strands in the current literature addressing this question. The first focuses on the role of institutions and goes back to the seminal contributions of La Porta et al. (1997, 1998) on how legal systems affect financial development. Acemoglu and Johnson (2005) have recently estimated the effects of different types of institutions on financial (and economic) development using an instrumental variables approach.[1] They find that property rights institutions, which regulate the relationship between ordinary citizens and those in power, have a strong positive effect on financial development, while contracting institutions, which regulate transactions among private citizens, have no effect on banking sector development and at best a weak effect on stock market development.[2]

A second strand in the literature looks at financial development from a political economy perspective. Based on the presumption that financial development can only take place if it does not conflict with the interests of a country's powerful elites, Rajan and Zingales (2003) provide an informal theory and empirical evidence suggesting that financial development is highest in countries that are open to goods trade and capital flows. They argue that financial development is only in these countries in the interest of the incumbent industrial elite as well as the incumbent financiers.[3]

In this paper, we provide a theoretical model with a political economy perspective that allows us to analyze the effects of property rights institutions, contracting institutions

[1] Beck et al. (2003) is an important predecessor of Acemoglu and Johnson (2005). They find that financial development depends on legal origin and settler mortality, which are Acemoglu and Johnson's instruments for the different types of institutions (see our discussion in section 5); and they argue that these effects are likely to be indirect through institutional quality.

[2] The distinction between predatory or property rights institutions, on the one hand, and contracting institutions, on the other hand, goes back to North (1981).

[3] A further strand in the financial development literature focuses on the effects of culture and religion (Stulz and Williamson, 2003).

and trade openness on financial development. In this model, each agent can produce either traditional or modern goods, but the production of modern goods requires an investment that exceeds an individual agent's capital endowment.[4] Hence, agents can only produce modern goods if they borrow sufficient capital. There is however a powerful elite that can persuade the government to repress the financial market for its own benefit. In particular, it can ask the government to set an interest rate ceiling and to channel all capital supplied toward its members. Financial repression therefore allows elite members to produce modern goods with low capital costs and to exclude ordinary agents from producing these goods. As a side effect financial repression leads to low financial depth and poor financial development. But sustaining financial repression is costly for the elite; and the repression costs increase in the institutional constraints on the elite and "its" government, i.e., in the quality of the property rights institutions. Under any financial market regime, it is moreover costly for capital lenders to ensure that borrowers repay their debt and their interest. These transaction costs decrease in the quality of the contracting institutions, which facilitate and ensure contract enforcement. We solve the model for the cases of both autarky and free trade.

We show that financial repression is more attractive for the elite under autarky than under free trade unless the world market price of modern goods is very high. The reason is that financial repression only serves to keep capital costs low under free trade, while it has the added advantage under autarky that it raises the price of modern goods by limiting their supply. Should the financial market be liberalized nevertheless, financial development is higher under free trade than under autarky if and only if the world market price of modern goods remains above the resulting autarky price of these goods. Trade openness thus increases equilibrium financial development if world market and autarky prices are roughly similar (in a clearly defined manner), but not necessarily otherwise.

Better property rights institutions tend to increase equilibrium financial development

[4]Throughout the paper, the goods are labeled "traditional" and "modern" to ease the exposition. It might be more appropriate to call them less and more capital intensive.

because they make financial repression more costly and therefore less attractive for the elite. The effect of contracting institutions is, however, ambiguous: Better contracting institutions and reduced transaction costs make the financial market more efficient. Lower transaction costs therefore make, on the one hand, financial repression more attractive for the elite and financial liberalization therefore less likely,[5] but, on the other hand, they increase financial development if the financial market is liberalized nevertheless. These predictions on how trade openness and the different types of institutions affect financial development are consistent with the existing evidence of, among others, Rajan and Zingales (2003) and Acemoglu and Johnson (2005). Our model thus offers a first (formal) explanation of the different effects of property rights and contracting institutions on financial development found by Acemoglu and Johnson (2005).[6]

We consider that our model nicely captures the general picture that emerges form the insightful studies of Termin and Voth (2007) and Benmelech and Moskowitz (2007) on financial repression in Great Britain in the 18th century and in the United States in the 19th century, respectively. Termin and Voth (2007) provide evidence that financial repression benefitted wealthy and politically well-connected borrowers at the expense of the less well-off. Benmelech and Moskowitz (2007) also find that financial repression served the interests of powerful groups. They provide ample evidence that financial repression was "used by incumbents with political power to control entry and hamper competition as well as to lower their own cost of capital" (Benmelech and Moskowitz, 2007, p. 2), and that the extent of financial repression depended on how costly it was.

In countries like Great Britain and the United States, financial repression is no longer common. According to our model, this could be due to the improvement in these countries' property rights institutions, which came, among others, in the form of extensions

[5]Lower transaction costs make financial repression more attractive because the elite can reap the full benefit of reduced transaction costs under financial repression, while this benefit is shared among all the agents in a liberalized financial market.

[6]Acemoglu and Johnson (2005, p. 988) call their own explanation of these different effects a "conjecture", and they conclude that more research is needed to understand these effects.

of the political franchise, or due these countries' increased trade openness. In many developing countries and emerging markets, financial repression has however been common until recently or even until today. In his seminal contribution, McKinnon (1973) reports that repressive policies that often include interest rate ceilings and credit "allocations [...] contingent on political and "establishment" connections" (McKinnon, 1973, p. 73) are pursued in many countries around the globe. While financial repression has presumably been introduced for developmental purposes in some of these countries, powerful and politically well-connected groups may even in such countries hijack repressive policies for their own benefit. A case in point is South Korea, which is generally considered to be one of the interventionist countries with the soundest economic management. Even there financial repression led to a credit allocation that favored politically well-connected groups in the 1970s (Cho, 1988, 1989) and in the 1990s before the Asian financial crisis (Borensztein and Lee, 2002). In a similar vein, the capital controls introduced in Malaysia during this crisis also benefitted politically connected firms (Johnson and Mitton, 2003).

While our paper builds on the contributions of Rajan and Zingales (2003), and Acemoglu and Johnson (2005), our approach differs in two main respects: First, we analyze the effects of trade openness, property rights institutions and contracting institutions within a single unified framework. Second, we present a formal theoretical model. This provides us with the opportunity to be more explicit about the roles that the different institutions play in the economy and about the means that the elite employs to repress the financial market. More importantly, it allows us to obtain new results. As mentioned before, we present the first (formal) explanation for the different effects of property rights and contracting institutions on financial development. Moreover, we get more nuanced results on the interplay between trade openness and financial development than those available in the existing literature, e.g., with respect to the role of the world market prices.

Our paper also relates to some mainly theoretical contributions. Aizenman (2007)

and Do and Levchenko (2007) also analyze how trade openness can affect financial development. Aizenman (2007) shows that trade openness can reduce the attractiveness of financial repression by facilitating capital flight through trade misinvoicing. Do and Levchenko (2007) show that trade openness increases financial development in countries with comparative advantages in financially intensive sectors, and decreases financial development in other countries. We consider these models to be complementary to ours. Pagano and Volpin (2005, 2006) choose an alternative political economy framework to study financial development. They analyze how the electoral system affects shareholder protection (which could be seen as an equivalent to the contracting institutions in our model) and, in turn, stock market development. Further, Oechslin (2006) presents a dynamic model of financial repression that allows him to quantify welfare effects. Our model, in contrast, allows us to analyze the effects of trade openness and different types of institutions.

The remainder of this paper is organized as follows: Section 2 introduces the model. Section 3 derives aggregate goods demand and supply under the different financial market regimes. Section 4 derives and discusses the determinants of the elite's choice of financial market regime and equilibrium financial development under free trade and autarky. Moreover, it analyzes the effects of trade openness on the elite's choice and on equilibrium financial development. Section 5 relates our model's predictions to the existing empirical literature. Section 6 concludes. Appendix A contains all proofs.

2 The Model

There is a small economy populated by a measure-one continuum of agents. A small group of γ agents constitutes the elite; the remaining $1-\gamma$ agents are ordinary citizens. Elite members are endowed with κ^e capital units, and ordinary citizens with $\kappa^o \leq \kappa^e$ capital units.

Each agent can either produce traditional goods x or modern goods y. The technology

for traditional goods production is such that he can produce $x = f(k)$ when investing $k \geq 0$ capital units, where $f(k)$ is continuous and satisfies $f_k(k) > 0$ and $f_{kk}(k) < 0$. The technology for modern goods production is such that he can produce $y = \alpha > 0$ when investing at least K capital units, and $y = 0$ otherwise.[7] We assume $\kappa^e < K < \mu_\kappa/\gamma$, where $\mu_\kappa \equiv \gamma\kappa^e + (1-\gamma)\kappa^o$. The first inequality implies that no agent is endowed with sufficient capital to produce modern goods. The second inequality ensures that there is sufficient capital in the economy such that at least γ agents could in principle produce modern goods. Each agent's preferences are represented by the quasi-linear utility function

$$u = x + v(y), \tag{1}$$

where $v(y)$ is continuous and satisfies $v_y(y) > 0$ and $v_{yy}(y) < 0$.[8]

Goods prices depend on whether the economy is open to free trade or not. Under free trade, denoted by subscript T, the relative price p_T of modern goods is determined on the world market and exogenous to the given economy. Under autarky, denoted by subscript A, the price p_A of modern goods adjusts to clear the domestic goods markets.

Besides a market for goods, a capital market[9] may also emerge because agents in the modern sector require more capital than they are endowed with while agents in the traditional sector can produce with less capital than they are endowed with. All agents can in principle borrow or lend capital, but it is costly for lenders to ensure that the borrowers repay their debt and their interest. As discussed by North (1990), such enforcement and transaction costs lower the potential gains from trade. We thus assume that whenever borrowers face the interest rate r, lenders receive only the net interest rate $r - c$, where $c > 0$ denotes the transaction costs necessary to ensure repayment.[10]

[7] We abstract from labor inputs. One could, e.g., think that each agent is endowed with one labor unit which is also required to produce x or y.

[8] As explained toward the end of this section, we introduce quasi-linear preferences to increase tractability and to simplify comparative static analysis. Notice however that quasi-linear preferences add a certain partial equilibrium flavor to our general equilibrium model.

[9] We use the terms "capital market" and "financial market" interchangeably.

[10] Results would remain unchanged if lenders had to bear the transaction costs.

These transaction costs decrease when the institutions that mediate between private parties and that facilitate and ensure contract enforcement become more effective, i.e., when the quality of the contracting institutions q_c increases. That is, $c = c(q_c)$ with $c_{q_c}(q_c) < 0$.

In a liberalized financial market, denoted by subscript L, the interest rate r_L adjusts to equate aggregate demand and supply of capital. The elite members can however persuade the government to repress the financial market for their own advantage. In particular, they can prompt the government to set an interest rate ceiling, which must not be exceeded by the actual interest rate, and they can determine the allocation of the aggregate capital supply in case it falls short of the aggregate capital demand (which will typically be the case).[11]

Sustaining financial repression is however difficult for the elite for two reasons: First, elite members are only sufficiently powerful to persuade the government to repress the financial market if they speak with a single voice, i.e., if they all agree on a particular repressive policy. Abstracting from enforceable intra-elite side-contracts, we thus assume that financial repression can only take place if it benefits all elite members. Second, ordinary agents will in general oppose financial repression because it benefits the elite at their expense. The elite and "its" government must thus pay the repression costs $C > 0$ to pass the corresponding financial market regulations, which are solely aimed at their own benefit, and to withstand or suppress the ordinary agents' request for financial liberalization. The repression costs depend on the institutional environment: In particular, they increase when the institutions that constrain the elite and its government and that make them accountable to the society as a whole become more effective, i.e., when the quality of the property rights institutions q_p increases. Hence, $C = C(q_p)$ with $C_{q_p}(q_p) > 0$. We assume that the elite pays the repression costs C if and only if they are lower than its members' aggregate benefits of financial repression.

[11] Our model is silent about whether the government implements these repressive policies by running a state bank (and banning private banks and stock markets) or by regulating the private financial sector.

The elite members' potential benefits of financial repression are lower capital costs and higher sales revenues due to a reduction in the aggregate supply of modern goods. But financial repression can only lead to these benefits if there are fewer elite members than producers of modern goods in a liberalized financial market. We subsequently focus on this case and assume $n_L > \gamma$, where n_L denotes the mass of modern goods producers in a liberalized financial market.[12] Further, notice that financial repression can only lower the elite members' capital costs if the aggregate supply of capital increases in the interest rate r. While this follows from the concavity of the production function $f(k)$ in our model, other mechanisms that would make the aggregate supply of capital increase in r would serve the purpose equally well.

The timing is as follows: First, the elite compares the benefits and costs of financial repression. Given trade openness $i \in \{A, T\}$, an individual elite member's benefit of financial repression is $\delta_i = u^e_{i,R} - u^e_{i,L}$, where $u^e_{i,j}$ denotes the utility that an elite member achieves under financial market regime $j \in \{L, R\}$ and where R denotes financial repression.[13] Hence, the elite asks the government to repress the financial market if and only if its aggregate net benefit of financial repression $B_i = \gamma\delta_i - C$ is positive.

Second, agents choose how to behave on the capital market. When it is liberalized, all agents can decide how much capital to borrow or to lend given the market-clearing interest rate $r_{i,L}$. Under financial repression, the elite members jointly decide what interest rate ceiling to impose and how to allocate the capital supplied. Ordinary agents may not have the possibility of borrowing capital in this case, but they can still decide how much capital to supply. These financial market decisions determine the share of modern goods producer $n_{i,j}$ as well as financial depth $d_{i,j}$, which equals the amount of capital borrowed or lent, respectively. Following the empirical literature, we interpret

[12] If $n_L \leq \gamma$, no binding interest rate ceiling could simultaneously benefit all elite members. Hence, there would be no financial repression.

[13] Due to the quasi-linear utility function, equivalent and compensating variation coincide. Hence, δ_i measures an elite member's willingness to pay to avoid a change from R to L as well as his willingness to pay to induce a change from L to R.

financial depth as a proxy for financial development.[14]

Third, agents produce either traditional goods or, given that they have sufficient capital, modern goods. Finally, interests are paid, and all agents sell and purchase their goods at either the world market price p_T or the domestic market clearing price $p_{A,j}$, depending on whether or not the economy is open to free trade.

We proceed as follows: In section 3, we derive aggregate demand and supply under both financial market regimes. In section 4, we then derive the elite's aggregate net benefit of financial repression B_i to study its choice of financial market regime and equilibrium financial depth d_i^* under both free trade and autarky. We also discuss how B_i and d_i^* depend on trade openness. This requires deriving the difference between the elite's benefit of financial repression under autarky and free trade, i.e., $\Delta B \equiv B_A - B_T$. While characterizing the properties of such differences in welfare differences is hardly possible in general, our relatively simple setting with quasi-linear preferences will allow us to establish interesting comparative static results.

3 Aggregate demand and supply under different financial market regimes

In this section, we first analyze how agents behave as consumers. We then study how they behave as goods producers and as lenders or borrowers of capital under the different financial market regimes, i.e., after financial liberalization and under financial repression.

[14]While in general one may think of "financial depth" and "financial development" as two different concepts, it is standard in the empirical literature to measure financial development by financial depth variables, such as stock market capitalization or credits to the private sector divided by GDP (see, among many others, Beck et al., 2003, Rajan and Zingales, 2003, and Acemoglu and Johnson, 2005).

3.1 Aggregate demand

The agents' behavior as consumers solely depends on their income m and the relative price of modern goods p; hence, the financial market regime and trade openness affect consumers only through their impacts on m and p.[15]

Given m and p, each agent maximizes his utility (1) subject to his budget constraint $x + py \leq m$ and $x, y \geq 0$. Optimization yields each agent's demand[16]

$$y^d(p) = v_y^{-1}(p) \quad \text{and} \quad x^d(p) = m - py^d(p), \tag{2}$$

where the concavity of $v(y)$ implies $y_p^d(p) < 0$. An agent's indirect utility is therefore

$$u = m + \omega(p) \quad \text{with} \quad \omega(p) \equiv v(y^d(p)) - py^d(p). \tag{3}$$

For later use, note that the envelope theorem implies $\omega_p(p) = -y^d(p)$.

Aggregate demand for modern goods is given by $y^d(p)$ as there is a measure-one continuum of agents demanding $y^d(p)$ modern goods each.

3.2 Aggregate supply after financial liberalization

We next analyze how agents behave as goods producers and as lenders or borrowers of capital when the financial market is liberalized. We start by discussing which agents produce which goods, and which producers borrow or lend capital, respectively. Given that there are $n_L > \gamma$ producers of modern goods, all γ elite members produce modern goods since financial transactions are costly and elite members need to borrow less capital for modern goods production than ordinary agents as $\kappa^e \geq \kappa^o$. Hence, all producers of traditional goods must be ordinary citizens. Further, producers of modern goods must

[15]For notational ease, we suppress trade openness and financial market regime subscripts in this section when there is no danger of confusion.

[16]For simplicity, we assume that agents consume both goods. That is, $0 < y^d(p) < m/p$ for all agents and all p.

borrow capital since $K > \kappa^e$. Producers of traditional goods could therefore borrow only from other agents in the traditional sector. But since they all produce with the same concave production function $f(k)$ and since they are all endowed with κ^o capital units, this cannot be mutually beneficial. All producers of traditional goods are therefore capital lenders, i.e., $k_L \leq \kappa^o$ and, hence, $k_L < K$.

When deciding how capital intensive their production should be and, thereby, how much capital to lend, traditional goods producing ordinary agents maximize their income

$$m^{o,x}(p_L, r_L, k_L) = f(k_L) + (\kappa^o - k_L)(r_L - c), \tag{4}$$

measured in units of the traditional good, taking the interest rate r_L as given. It follows from the first-order condition $f_k(k_L) = r_L - c$ that they choose to produce with

$$k_L = k(r_L) \equiv \max\{f_k^{-1}(r_L - c), 0\} \tag{5}$$

capital units. It follows from the concavity of $f(k_L)$ that $k_r(r_L) < 0$ if $k_L > 0$, and also that k_L increases in c. Hence, traditional goods producing ordinary agents earn

$$m^{o,x}(p_L, r_L) \equiv m^{o,x}(p_L, r_L, k(r_L)). \tag{6}$$

Elite members, who all produce modern goods, earn

$$m^{e,y}(p_L, r_L) = p_L\alpha - (K - \kappa^e)r_L, \tag{7}$$

and modern goods producing ordinary agents earn

$$m^{o,y}(p_L, r_L) = p_L\alpha - (K - \kappa^o)r_L. \tag{8}$$

When the financial market is liberalized, all agents can choose in which sector to

work. In equilibrium it must thus hold that no agent would be better off by switching sector.[17] This requires

$$\begin{aligned}\Delta m^o(p_L, r_L) &\equiv m^{o,y}(p_L, r_L) - m^{o,x}(p_L, r_L) \\ &= p_L\alpha - f(k(r_L)) - (K - k(r_L))r_L + (\kappa^o - k(r_L))c = 0, \end{aligned} \tag{9}$$

such that the two sectors are equally attractive for ordinary agents and that the modern sector is indeed weakly more attractive for elite members.[18] Condition (9) implicitly defines the interest rate that prevails in a liberalized financial market as a function of the modern goods price:

$$r_L = r(p_L). \tag{10}$$

Total differentiation of condition (9) and application of the envelope theorem implies

$$r_p(p_L) = \frac{\alpha}{K - k_L} > 0, \tag{11}$$

where the inequality follows from $k_L < K$. The intuition is the following: An increase in p_L tends to make the modern sector more attractive than the traditional sector; hence, r_L must rise to ensure that the two sectors remain equally attractive for ordinary agents. For later use, define $k(p_L) \equiv k(r(p_L))$, and note that $k_p(p_L) < 0$ (since $k_r(r_L) < 0$ and $r_p(p_L) > 0$).

No producer of traditional goods would ever leave capital unused or lend capital at any interest rate $r_L \leq c$, while no producer of modern goods would ever borrow more capital than necessary for modern goods production (unless $r \leq 0$). The capital allocation k_L of the producers of traditional goods therefore directly determines the population share n_L of producers of modern goods and, in turn, the aggregate supply of modern and traditional goods, y_L^s and x_L^s. In particular, it must hold that $n_L K + (1 - n_L)k_L = \mu_\kappa$,

[17] Notice that there is always domestic production of modern goods since $n_L > \gamma$, and domestic production of traditional goods since $\mu_\kappa < K$.

[18] The latter follows from $\partial \Delta m^o(p_L, r_L)/\partial \kappa^o = c > 0$ and $\kappa^e \geq \kappa^o$.

such that

$$n_L = n(p_L) \equiv \frac{\mu_\kappa - k(p_L)}{K - k(p_L)} \tag{12}$$

with $n_p(p_L) > 0$ (since $\partial n_L / \partial k(p_L) < 0$ and $k_p(p_L) < 0$). It directly follows that

$$y_L^s = y^s(p_L) \equiv \alpha n(p_L) \quad \text{and} \quad x_L^s = x^s(p_L) \equiv [1 - n(p_L)] f(k(p_L)) \tag{13}$$

with $y_p(p_L) > 0$ and $x_p(p_L) < 0$.

The share of modern goods producers $n_L > \gamma$ moreover determines the amount of capital borrowed, i.e., financial development

$$d_L = d(p_L) \equiv \gamma(K - \kappa^e) + [n(p_L) - \gamma](K - \kappa^o). \tag{14}$$

As the focus of this paper is on financial development, we would like to highlight the following result:

Lemma 1 *After financial liberalization, financial development d_L increases in p_L, α and q_c.*

Financial development d_L increases in the contracting institutions' quality q_c because lower transaction costs c raise the financial market's efficiency, and in the sales revenues $p_L \alpha$ of modern goods producers because a more attractive capital-intensive sector raises the demand for capital.

3.3 Aggregate supply under financial repression

We next focus on the supply side of the economy under financial repression. In particular, we derive the interest rate ceiling and the capital allocation that the elite members ask the government to impose when they have already decided to repress the financial market.

Any interest rate ceiling weakly higher than r_L would have no effect on capital market outcomes. Therefore, whenever the elite makes the costly decision to ask for financial

repression, it chooses a binding interest rate ceiling, i.e., a ceiling strictly below r_L.

Given a binding interest rate ceiling, such that $r_R < r_L$, aggregate capital supply decreases and falls short of aggregate capital demand. This has several effects: First, it decreases the share of modern goods producers and, consequently, the aggregate supply of modern goods. That is, $n_R < n_L$ and $y_R^s < y_L^s$. Second, agents who borrow capital and produce modern goods become better off, while agents who lend capital and produce traditional goods become worse off unless the price of modern goods were increasing in the supply of these goods.[19] Each elite member wants therefore to produce modern goods and benefits from financial repression if and only if he is allocated $K - \kappa^e$ capital units. Moreover, all elite members have a preference for a low interest rate ceiling since their incomes

$$m^{e,y}(p_R, r_R) = p_R\alpha - (K - \kappa^e)r_R \tag{15}$$

decrease in r_R. The elite members thus agree that the interest rate ceiling $\overline{r}$ should be such that the ordinary agents jointly supply exactly $(1-\gamma)(\kappa^o - k(\overline{r})) = (K - \kappa^e)\gamma$ capital units. Knowing equation (5), they therefore set the interest rate ceiling

$$\overline{r} \equiv f_k\left(\frac{(1-\gamma)\kappa^o - \gamma(K - \kappa^e)}{1-\gamma}\right) + c. \tag{16}$$

A lower ceiling would make the aggregate supply of capital falling short of the elite's aggregate capital demand $(K - \kappa^e)\gamma$; and a higher ceiling would unnecessarily reduce the elite members' income.

It holds by construction of $\overline{r}$ that $r_R = \overline{r} < r_L$ and $n_R = \gamma < n_L$. Consequently, $k_R = k(\overline{r}) > k_L$ and $y_R^s = \alpha\gamma < y_L^s$. Moreover:

Lemma 2 *Under financial repression, financial development is* $d_R = \gamma(K - \kappa^e) < d_L$.

Financial development d_R equals the elite's aggregate capital demand $\gamma(K - \kappa^e)$ because

[19] In our model, the world market price p_T is exogenous and therefore independent of y_T^s, and the autarky price p_A will decrease in y_A^s (see section 4.2).

the elite chooses the interest rate ceiling $\overline{r}$ to induce the ordinary agents to supply exactly that amount of capital. Hence, it increases in the elite's size γ and in each elite member's capital requirement $(K - \kappa^e)$.

4 Equilibrium financial development

In this section, we derive the elite's choice of financial market regime and equilibrium financial development under free trade and autarky. We thereby focus on the effects of property rights and contracting institutions. Moreover, we compare the results under free trade and autarky to analyze the effect of trade openness.

4.1 Free trade

We start by looking at the case of free trade, in which the price p_T of modern goods is exogenous and, hence, independent of the financial market regime. We first derive the elite members' benefits of financial repression to study their choice of financial market regime. We then discuss the determinants of equilibrium financial development.

Under free trade, all agents face two separate optimization problems: As consumers, they spend their income to maximize their utility (see section 3.1); and as producers and capital owners, they make their capital allocation decisions and, if possible, their sectorial choice so as to maximize their income (see sections 3.2 and 3.3). Elite members further choose the financial market regime that makes them better off; they thereby take all the agents' optimizing behavior under the different financial market regimes as given. Since this choice does not affect goods prices under free trade, elite members choose the regime that maximizes their income. All results derived in this section are therefore independent of the functional form of the utility function (1).

It follows from our discussion in section 3 that each elite members achieves income $m^{e,y}(p_T, \overline{r})$ and utility $u^e_{T,L} = m^{e,y}(p_T, \overline{r}) + \omega(p_T)$ under financial repression, and income

$m^{e,y}(p_T, r_{T,L})$ and utility $u^e_{T,L} = m^{e,y}(p_T, r_{T,L}) + \omega(p_T)$ after financial liberalization. His benefit of financial repression is thus

$$\delta_T \equiv u^e_{T,R} - u^e_{T,L} = m^{e,y}(p_T, \overline{r}) - m^{e,y}(p_T, r_{T,L}) = (K - \kappa^e)(r_{T,L} - \overline{r}), \tag{17}$$

where the second equality follows from equations (7) and (15).

The elite members ask the government to repress the financial market if and only if their aggregate benefits $\gamma\delta_T$ exceed the repression costs C, i.e., if and only if $B_T \equiv \gamma\delta_T - C > 0$.

Proposition 1 *Under free trade, the elite only benefits from financial repression because of lower capital costs (i.e. $r_{T,L} > \overline{r}$). Financial repression is the more attractive for the elite (i.e. B_T is the higher), the higher p_T, α and q_c, and the lower q_p.*

Proposition 1 highlights that in the case of free trade financial repression only benefits the elite members, who are all producing capital-intensive modern goods, by lowering their capital costs. Financial repression is thus more beneficial for elite members, the larger the interest rate difference $r_{T,L} - \overline{r}$ and, given $r_{T,L} - \overline{r}$, the higher their capital requirement $K - \kappa^e$. The elite's benefit of financial repression increases in the modern goods producers' sales revenues $p_T\alpha$ since a more attractive modern sector rises the free-market interest rate $r_{T,L}$.

Better contracting institutions also increase the elite's benefit of financial repression. The reason is as follows: An increase in the quality of the contracting institutions q_c reduces the transactions costs c and thereby increases the efficiency of the financial market. Under financial repression, the elite can decrease the interest rate ceiling $\overline{r}$ one-to-one when c falls, as any smaller decrease would lead to an aggregate capital supply that exceeds the elite's aggregate capital demand $(K - \kappa^e)\gamma$. In a liberalized financial market, however, a fall in c leads to a less than one-to-one interest rate decrease because $r_{T,L}$ adjusts to ensure that the two sectors remain equally attractive (see condition (9)).

Better contracting institutions thus increase the elite members' incentive to repress the financial market because they can reap the whole benefit of the reduced transaction costs and the associated efficiency gain under financial repression, while this benefit is shared among all agents after financial liberalization. An increase in the quality of the property rights institutions q_p, on the other hand, raises the elite's repression costs C and therefore makes financial repression unambiguously less attractive for the elite.

Let us now look at equilibrium financial development. The elite asks the government to repress the financial market if its aggregate benefit of financial repression, $\gamma\delta_T$, exceeds the repression costs C, i.e., if $B_T > 0$. In this case, financial development equals $d_{T,R} = (K - \kappa^e)\gamma$. Hence, a repressed financial market's development increases in the elite's size γ and in the elite members' capital demand $K - \kappa^e$. But if the repression costs exceed the elite's aggregate benefit, i.e., if $B_T < 0$, the elite chooses not to repress the financial market and financial development increases to $d_{T,L} > d_{T,R}$. This is summarized in the first part of the following proposition:

Proposition 2 *Under free trade, equilibrium financial development is* $d_T^* = d_{T,R} = (K - \kappa^e)\gamma$ *if* $B_T > 0$*, and* $d_T^* = d_{T,L} > d_{T,R}$ *otherwise. It weakly increases in* q_p*, while the effects of* p_T*,* α *and* q_c *are ambiguous.*

Proposition 2 states that equilibrium financial development d_T^* tends to increase in the quality of the property rights institutions q_p. The reason is that better property rights institutions make financial repression more costly for the elite and, therefore, less likely (see Proposition 1), while they do not directly affect financial development under any financial market regime (see Lemmas 1 and 2).

Changes in the quality of the contracting institutions q_c however have countervailing effects on equilibrium financial development d_T^*. On the one hand, a rise in q_c increases financial development after financial liberalization $d_{T,L}$ because lower transaction costs raise the financial market's efficiency (see Lemma 1). On the other hand, a rise in q_c makes financial repression more attractive for the elite because the elite can only reap

the full benefits of the reduced transaction costs when they repress the financial market (see Proposition 1). It is due to these countervailing effects that the net effect of better contracting institutions on equilibrium financial development d_T^* is ambiguous.

Similarly as the contracting institutions' quality, the attractiveness of modern goods production also has an ambiguous effect on d_T^*: The elite's incentive to repress the financial market and financial development after financial liberalization both increase in the sales revenues $p_T\alpha$ of modern goods producers.

4.2 Autarky

In this section, we focus on the elite's choice of financial market regime and equilibrium financial development under autarky.

The main difference compared to the case of free trade is that goods prices are no longer exogenous, but that they adjust to clear the domestic goods markets. As a consequence, goods prices (can) differ across financial market regimes.

Lemma 3 *For any financial market regime $j \in \{L, R\}$, there exists a unique market-clearing price $p_{A,j}$ of modern goods. These prices satisfy $p_{A,R} > p_{A,L}$, with $p_{A,R}$ decreasing in α and γ, and $p_{A,L}$ decreasing in α and q_c.*

Given these autarky prices, each elite member achieves utility $u_{A,R}^e = m^{e,y}(p_{A,R}, \overline{r}) + \omega(p_{A,R})$ under financial repression and utility $u_{A,L}^e = m^{e,y}(p_{A,L}, r_{A,L}) + \omega(p_{A,L})$ after financial liberalization. His benefit of financial repression is thus

$$\delta_A \equiv u_{A,R}^e - u_{A,L}^e = (K - \kappa^e)(r_{A,L} - \overline{r}) + (p_{A,R} - p_{A,L})\alpha + \omega(p_{A,R}) - \omega(p_{A,L}), \quad (18)$$

and the elite's aggregate net benefit is $B_A \equiv \gamma\delta_A - C > 0$.

Proposition 3 *Under autarky, the elite benefits from financial repression because of lower capital costs (i.e. $\overline{r} < r_{A,L}$) and higher prices of modern goods (i.e. $p_{A,R} > p_{A,L}$).*

Financial repression is the more attractive for the elite (i.e. B_T is the higher), the higher q_c and the lower q_p.

Equation (18) suggests that financial repression has three effects on the welfare of an individual elite member under autarky. The first effect is the same as under free trade: Financial repression keeps the interest rate down and, therefore, his capital costs low. The other two effects are new and due to the endogeneity of goods prices under autarky. There is a positive effect because financial repression keeps prices of modern goods and, thereby, sales revenues high by precluding ordinary agents from producing these goods. That is, $p_{A,R}\alpha > p_{A,L}\alpha$. But there is also a negative effect because higher prices reduce the purchasing power of a fixed income unit. Hence, $\omega(p_{A,R}) < \omega(p_{A,L})$. Since elite members supply more modern goods than they demand even under the lowest autarky price, $p_{A,L}$, the positive price effect dominates. The elite members' benefit δ_A of financial repression is thus again strictly positive.

Contracting and property rights institutions have the same effects on financial repression as under free trade: Better contracting institutions and lower transaction costs c again make financial repression more attractive by benefiting exclusively elite members under financial repression, but all agents otherwise; and better property rights institutions again make financial repression less likely because they raise the elite's repression costs C.

Let us again look at equilibrium financial development:

Proposition 4 *Under autarky, equilibrium financial development is $d_A^* = d_{A,R} = (K - \kappa^e)\gamma$ if $B_A > 0$, and $d_A^* = d_{A,L} > d_{A,R}$ otherwise. It weakly increases in q_p, while the effect of q_c is ambiguous.*

Hence, equilibrium financial development is again equal to $d_A^* = (K-1)\gamma$ if the elite's benefits of financial repression outweigh its costs, i.e., if $B_A > 0$. Otherwise, the financial market is liberalized and financial development rises to $d_A^* = d_{A,L} > (K-1)\gamma$. Financial development after financial liberalization $d_{A,L}$ again increases in the quality of the

contracting institutions q_c. The effect of q_c on equilibrium financial development d_A^* is therefore again ambiguous: better contracting institutions increase the elite's incentive to repress the financial market, but given that the financial market is liberalized nevertheless, they increase d_A^*. The effect of the quality of the property rights institutions q_p, on the other hand, is again unambiguous: better property rights institutions tend to raise equilibrium financial development d_A^* because they make financial repression less likely, while they do not affect financial development under any financial market regime.

4.3 Free Trade vs Autarky

In this section, we compare the elite's choice of financial market regime and equilibrium financial development under autarky and free trade to analyze how they depend on trade openness.

The difference between the elite's aggregate net benefit of financial repression under autarky and free trade is

$$\begin{aligned} \Delta B &\equiv B_A - B_T = \gamma(\delta_A - \delta_T) \\ &= \gamma[(K-1)(r_{A,L} - r_{T,L}) + (p_{A,R} - p_{A,L})\alpha + \omega(p_{A,R}) - \omega(p_{A,L})], \end{aligned} \tag{19}$$

where the latter equality follows from equations (17) and (18).

Proposition 5 *Financial repression is more attractive for the elite under autarky than under free trade (i.e., $\Delta B \geq 0$) if and only if $p_T \leq p'_T$, where p'_T satisfies $p'_T \in (p_{A,R}, \infty)$ and decreases in γ.*

Proposition 5 implies that the elite's benefit of financial repression is higher under autarky than under free trade unless $p_T > p'_T$, i.e., unless the world market price p_T is very high and even higher than the market-clearing price $p_{A,R}$ under autarky when the elite restricts the supply of modern goods by repressing the capital market. The reason is that financial repression has two positive effects under autarky, but only one under

free trade: Under both trade regimes, financial repression keeps down the elite members' capital costs for modern goods production. Moreover, it also keeps the domestic supply of modern goods low by precluding ordinary agents from producing these goods. This raises the modern goods price $p_{A,R} > p_{A,L}$ and, consequently, the elite members' income under autarky, but not under free trade.[20]

The elite's benefit of financial repression is however higher under free trade than under autarky if $p_T > p'_T$, because such a high world market price p_T leads to a very high market-clearing interest rate $r_{T,L}$ and, therefore, to very large benefits of financial repression under free trade, which even exceed the various benefits of financial repression under autarky. It seems unlikely however that $p_T > p'_T$, in particular if the elite is small and the autarky price $p_{A,R}$ of modern goods therefore high.

Let us now compare financial development under free trade and autarky:

Proposition 6 *After financial liberalization, financial development is higher under free trade than under autarky (i.e. $d_{T,L} \geq d_{A,L}$) if and only if $p_T \geq p_{A,L}$, while it is independent of trade openness under financial repression (i.e. $d_{T,R} = d_{A,R}$). Trade openness thus increases equilibrium financial development (i.e. $d^*_T \geq d^*_A$) if $p_T \in [p_{A,L}, p'_T]$. Otherwise, the effect of trade openness on equilibrium financial development is ambiguous.*

Under financial repression, financial development does not depend on trade openness because the elite simply sets the interest rate ceiling $\overline{r}$ that induces the ordinary agents to supply the $\gamma(K - \kappa^e)$ capital units it demands. Proposition 6 implies that after financial liberalization, financial development is higher under whatever trade regime the prices of modern goods are higher. The reason is that high prices are associated with high free-market interest rates, and that high prices make modern goods production

[20] A closer look at the proof of Proposition 5 is helpful to understand why $\Delta B > 0$ for any $p_T \leq p_{A,R}$. Agents who produce modern goods benefit more from a rise in p_A as producers than they loose from such a rise as consumers, at least when $p_A > p_{A,L}$. They would therefore be better off in the hypothetical case with price $p_{A,R} > p_{A,L}$ and interest rate $r(p_{A,R}) < r_{A,L}$ than in the (A, L)-equilibrium (i.e. the equilibrium under autarky and financial liberalization). Since ΔB equals the welfare difference between this hypothetical case and the (A, L)-equilibrium if $p_T = p_{A,R}$, it follows that $\Delta B > 0$ if $p_T = p_{A,R}$. Since ΔB decreases in p_T, it holds that $\Delta B > 0$ for any $p_T \leq p_{A,R}$.

attractive while high interest rates make supplying capital attractive for those in the traditional sector, such that high prices and high interest rates jointly lead to high financial development. It thus follows from Lemma 3 and Proposition 6 that the exogenous world market price p_T is the more likely to exceed the autarky price $p_{A,L}$ and, hence, that financial development is the more likely to be higher under free trade than under autarky, the higher the modern sector productivity α and the quality of the contracting institutions q_c.

Proposition 6 implies that the effect of trade openness on equilibrium financial development depends on how the world market price p_T compares to the autarky prices $p_{A,L}$ and $p_{A,R}$. Trade openness increases equilibrium financial development if $p_T \in [p_{A,L}, p'_T]$, i.e., if world market prices are roughly similar to the autarky prices. In this case, financial liberalization is more attractive for the elite under free trade than under autarky, and financial development after financial liberalization is also higher under free trade.

The effect of trade openness on equilibrium financial development is however ambiguous if p_T is either very high or low. If $p_T > p'_T$ $(> p_{A,R})$, the elite's benefits of financial repression and financial development after financial liberalization are both higher under free trade; and if $p_T < p_{A,L}$, the elite's benefits of financial repression and financial development after financial liberalization are both higher under autarky.

Since greater trade openness unambiguously increases financial development for some parameter constellations while its effect is ambiguous for others, our model suggests that when looking at a diverse sample of countries, greater trade openness should on average tend to increase financial development. Nevertheless, the ambiguous effect of trade openness for some parameter constellations suggests that the politico-economic consequences of changes in trade openness on financial development might be less straightforward than the literature has so far acknowledged.

5 Empirical Evidence

In this section, we argue that our model's predictions about the effects of trade openness, property rights institutions and contracting institutions on financial development are consistent with the existing empirical literature.

One of our model's predictions is that greater trade openness tends to increase financial development, at least, if world market and autarky prices are roughly similar. There is considerable cross-country evidence for a positive effect of trade openness on financial development: Svaleryd and Vlatchos (2002) find a significant relationship between financial development and trade openness, with some evidence for (Granger) causality running in both directions. Consistent with their theory, Rajan and Zingales (2003) find a positive effect of trade openness on financial development, in particular in times of high cross-border capital flows. Similarly, Demetriades and Hook Law (2005) find that trade openness promotes financial development if capital inflows are high. Huang and Temple (2005) find a positive effect of trade openness on financial development in high income countries. Rajan and Zingales (2003) and Huang and Temple (2005) follow Frankel and Romer (1999) and establish causality by instrumenting for trade openness with constructed trade shares from gravity equations.

Our model further predicts that higher quality property rights institutions reduce the elite's incentive to repress the financial market and tend therefore to increase equilibrium financial development, but that higher quality contracting institutions have an ambiguous effect on equilibrium financial development. The empirical study by Acemoglu and Johnson (2005), which we discussed in the introduction, estimates the impact of property rights and contracting institutions. They measure property rights and contracting institutions by constraints on the executive and legal formalism, and they use settler mortality and legal origin to instrument for these measures. They find that constraints on the executive have a strong positive effect on financial development in general, while legal formalism has no effect on banking sector development and at best a weak effect on

stock market development. The strong effect of property rights institutions is consistent with our predictions, and the non-robust effect of contracting institutions is also not surprising given the ambiguous effect they have in our model.

Girma and Shortland (2007) and Huang (2005) provide further evidence that more democratic institutions, which increase the accountability of those in power, increase financial development. In addition, Haber (2005) argues that differences in the institutions responsible for political competition were the major reason for the different evolution of the banking systems in Mexico and the United States from independence to the early 20th century.

6 Conclusions

In this paper, we have presented a political economy model in which the elite can repress financial development. Greater trade openness and better property rights institutions, which result in more constraints on those in power, tend both to make financial repression less attractive for the elite and thereby to increase financial development. Better contracting institutions, which lower transaction costs, make financial repression more attractive for the elite, but increase financial development should the financial markets be liberalized nevertheless. Their effect on equilibrium financial development is thus ambiguous. The results of our model are consistent with the existing empirical evidence and provide an explanation for the different effects of property rights and contracting institutions on financial development found by Acemoglu and Johnson (2005).

Once we understand the effects of the different types of institutions on financial (and economic) development, it seems worthwhile to think about the determinants of these institutions. While institutions are in general relatively persistent and therefore partly determined by historical events (see, e.g., La Porta et al., 1998; Hall and Jones, 1999; Acemoglu et al., 2001), there can be little doubt that political actors can shape them to some extent as well. A fruitful direction for future research seems therefore to endogenize

property rights and contracting institutions in political economy models such as the one presented in this paper.[21]

[21] A first step in this direction is taken by Besley and Persson (2007) who present a model with endogenous contracting institutions. The models of Pagano and Volpin (2005, 2006) could also be interpreted as models with endogenous contracting institutions.

Appendix A

Proof of Lemma 1: Inequality (11) implies $n_p(p_L) > 0$, and it follows from equation (14) and $K > \kappa^o$ that $\partial d_L / \partial n(p_L) > 0$. Hence, d_L must increase in p_L. It is easy to see that changes in α must have the same effects as changes in p_L (see equations (5), (9), (12) and (14)). Hence, d_L must also increase in α. An increase in q_c lowers c, which, in turn, decreases k_L, as we argued after equation (5). The decrease in k_L then increases n_L and, therefore, d_L. Hence, d_L also increases in q_c. ■

Proof of Lemma 2: It holds by construction of $\overline{r}$ that $d_R = \gamma(K - \kappa^e)$. It follows from equation (14), $n_L > \gamma$ and $K > \kappa^o$ that $d_R < d_L$. ■

Proof of Proposition 1: $K > \kappa^e$ and $r_{T,L} > \overline{r}$ imply $\delta_T > 0$ and that financial repression lowers the elite members' capital costs. Equation (17) shows that financial repression has no further benefits for elite members.

Equation (11) implies that $r_{T,L}$ increases in p_T; total differentiation of condition (9) and application of the envelope theorem implies $dr_{T,L}/d\alpha > 0$. Since $\overline{r}$ and C are independent of p_T and α, δ_T and B_T must increase in p_T and α.

Total differentiation of condition (9) and application of the envelope theorem implies $dr_{T,L}/dc = (\kappa^o - k_{T,L})/(K - k_{T,L}) < 1$, where the inequality follows from $K > \kappa^o > k_{T,L}$. Equation (16) implies $d\overline{r}/dc = 1$. Hence, δ_T and B_T must decrease in c and, since $c_{q_c}(q_c) < 0$, increase in q_c. A rise in q_p has no effect on δ_T, but it lowers B_T since $C_{q_p}(q_p) > 0$. ■

Proof of Proposition 2: All results directly follow from Lemmas 1 and 2 and Proportion 1. ■

Proof of Lemma 3: Prices $p_{A,L}$ and $p_{A,R}$ are determined by $y^d(p_{A,L}) = y^s(p_{A,L})$ and $y^d(p_{A,R}) = \alpha\gamma$, respectively. They are unique since $y^s_p(p_L) > 0$ and $y^d_p(p) < 0$ (as seen in sections 3.1 and 3.2). Further, it follows from market clearing, $y^d_p(p) < 0$ and $y^s_{A,R} = \alpha\gamma < y^s_{A,L}$ (as seen in section 3.3) that $p_{A,R} > p_{A,L}$ and that $p_{A,R}$ must decrease in α and γ. It follows from Lemma 1 and its proof that $n_{A,L}$ and, consequently, $y^s_{A,L}$ increase in α and q_c. Market clearing thus implies that $p_{A,L}$ must decrease in α and q_c. ■

Proof of Proposition 3: $K > \kappa^e$ and $r_{A,L} > \overline{r}$ imply that financial repression benefits elite members by lowering their capital costs. To see that higher prices p_A benefit elite members, note that $d(p_A\alpha + \omega(p_A))/dp_A = \alpha + \omega_p(p_A) > 0$ for all $p_A \geq p_{A,L}$ because $\alpha > y^s(p_A)$, $\omega_p(p_A) = -y^d(p_A)$ and $y^s(p_A) \geq y^d(p_A)$ for all $p_A \geq p_{A,L}$. Since $p_{A,R} > p_{A,L}$, it follows that $(p_{A,R} - p_{A,L})\alpha + \omega(p_{A,R}) - \omega(p_{A,L}) > 0$. Consequently, $\delta_A > 0$.

Note that $d\delta_A/dc = (K - \kappa^e)(dr_{A,L}/dc - d\overline{r}/dc) + \phi(p_{A,R}) - \phi(p_{A,L})$, where $\phi(p_A) \equiv (\alpha + \omega_p(p_A))(dp_A/dc)$. Following the proof of Proposition 1, it can be shown that $dr_{A,L}/dc < d\overline{r}/dc = 1$. Since $y^s_{A,R} = \alpha\gamma$ is independent of c, $dp_{A,R}/dc = 0$ and, hence, $\phi(p_{A,R}) = 0$. It follows from Lemma 3 that $p_{A,L}$ increases in c and from above that $\alpha + \omega_p(p_{A,L}) > 0$, such that $\phi(p_{A,L}) > 0$. Consequently, $d\delta_A/dc < 0$ and $dB_A/dc < 0$. Since $c_{q_c}(q_c) < 0$, δ_A and B_A must increase in q_c. A rise in q_p has no effect on δ_A, but it lowers B_A since $C_{q_p}(q_p) > 0$. ■

Proof of Proposition 4: All results directly follow from Lemmas 1 and 2 and Proportion 3. ■

Proof of Proposition 5: Inequality (11) and equation (19) imply that ΔB strictly decreases in p_T. Moreover, inequality (11) and $k_L < K$ imply $\lim_{p_T \to \infty} r_{T,L} = \infty$, such that $\lim_{p_T \to \infty} \Delta B = -\infty$. It further follows from the continuity of $f(k)$ that ΔB is continuous in p_T.

Define $\delta' \equiv m^{e,y}(p_{A,R}, r(p_{A,R})) + \omega(p_{A,R}) - u^e_{A,L}$. Equations (11), (12) and (13) imply $dm^{e,y}(p, r(p))/dp_L \geq y^s(p)$. Moreover, it holds that $\omega_p(p) = -y^d(p)$ and that $y^s(p) > y^d(p)$ if and only if $p > p_{A,L}$. Consequently, $d[m^{e,y}(p, r(p)) + \omega_p(p)]/dp > 0$ for $p > p_{A,L}$. Since $p_{A,R} > p_{A,L}$, it therefore holds that $\delta' > 0$. Note that $\Delta B = \delta'$ if $p_T = p_{A,R}$ such that $r_{T,L} = r(p_{A,R})$. Hence, $\Delta B > 0$ if $p_T = p_{A,R}$. Since (i) ΔB is continuous and strictly decreasing in p_T, (ii) $\Delta B > 0$ if $p_T = p_{A,R}$, and (iii) $\lim_{p_T \to \infty} \Delta B < 0$, there must exist a unique $p'_T \in (p_{A,R}, \infty)$ satisfying $\Delta B = 0$, and it must hold that $\Delta B \geq 0$ if and only if $p_T \leq p'_T$.

A rise in γ decreases $p_{A,R}$, as shown in Lemma 3, but has no effect on $r_{A,L}$, $r_{T,L}$ and $p_{A,L}$. The proof of Proposition 3 shows that $p_{A,R}\alpha + \omega(p_{A,R})$ increases in $p_{A,R}$ (as $p_{A,R} > p_{A,L}$). Hence, ΔB must increase in $p_{A,R}$. It then follows from Lemma 3 that ΔB must decrease in γ. Consequently, p'_T decreases in γ as well. ■

Proof of Proposition 6: It follows from Lemma 1 that $d_{T,L} \geq d_{A,L}$ if and only if $p_T \geq p_{A,L}$, and from Lemma 2 that $d_{T,R} = d_{A,R}$. Together with Proposition 5, these results imply that $d_T^* \geq d_A^*$ if $p_T \in [p_{A,L}, p_T']$, and also that it is unclear whether $d_T^* \geq d_A^*$ or $d_T^* < d_A^*$ otherwise. ■

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