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Slow recoveries

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Abstract

Economies respond differently to aggregate shocks that reduce output. While some countries rapidly recover their pre-crisis trend, others stagnate. Recent studies provide empirical support for a link between aggregate growth and plant dynamics through its effect on productivity: the entry and exit of firms and the reallocation of resources from less to more efficient firms explain a relevant part of transitional productivity dynamics. In this paper, we use a stochastic general equilibrium model with heterogeneous firms to study the effect on aggregate short-run growth of policies that distort the process of birth, growth, and death of firms, as well as the reallocation of resources across economic units. Our findings show that indeed policies that alter plant dynamics can explain slow recoveries. We also find that output losses associated to delayed recoveries are large.

JEL: D21; D24; L16; L60; O40
Keywords: Productivity growth; Plant dynamics; Policy; General equilibrium

1. Introduction

Why do some countries recover with relative ease from negative shocks while others suffer considerably? Exogenous shocks like the deterioration in terms of trade, the reduction in foreign capital flows, and the rise in international interest rates are common to many developing countries. Although these shocks initially produce a similar fall in economic activity, the recovery paths in their aftermath differ markedly across countries.

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This is, for instance, what Bergoeing et al. (2002) found when they compared the experiences of Mexico and Chile in the 1980s. Being affected by similar shocks in the onset of the 1980s debt crisis, Chile was able to recover and "find" a decade that turned out to be lost for Mexico and most of Latin America. Bergoeing et al. argue that a key element in Chile's ability to recover was a bankruptcy law that facilitated the retrenchment of weak firms and creation of stronger companies.

Recovery processes are intrinsically costly, as they require significant amounts of resource reallocation. Depending on the type and intensity of shocks, some firms and sectors in the economy contract while others expand. Labor and capital resources are freed by declining firms in order to be used by growing ones, but not without difficulty. Resource reallocation implies adjustment, and this is costly whether it means the adoption of new technologies and more capital utilization by expanding firms or the shredding of labor and capital, even to the point of disappearance, by weakening firms. Without this costly process, however, economies would be unable to resume full economic activity in the aftermath of shocks.

The main hypothesis of this paper is that slow and costly recoveries are the result of impediments to the natural process of resource reallocation. Some of these impediments are inherent to the adjustment process and thus can be considered as natural transaction costs (see Caballero and Hammour, 1994). However, these impediments can also result from government policy interventions, such as excessive labor protection, directed credit to inefficient sectors, entry barriers to the establishment of new plants and firms, and burdensome bankruptcy laws. By reducing the extent of restructuring, these obstacles alter the recovery path that follows aggregate shocks, inducing the stagnation of economic activity during long periods of time.

Recent studies have underscored the connection between rigidities and recovery. Prescott (2002) provides a comprehensive analysis of this link, making clear that this is an important issue not only for developing countries but also for developed economies. The U.S. depression of the 1930s had many causes, but it is now clear that policy distortions exacerbated the slowdown. For instance, Cole and Ohanian (1999) argue that labor market regulations stalled the recovery process in the aftermath of the stock market crash.

More recently, Germany and Japan, the second and third largest economies in the world, have experienced their worst recessions since the end of World War II. Germany's GDP growth rate has been half as that in the rest of Europe over the last 10 years, with the costs of reunification playing only a limited role in the country's stagnation. As Broadbent et al. (2004) argue, the subsidized interest rates prevalent in Germany in the 1990s led to overinvestment and low capital returns. After the European Commissioner dictated in 2001 that public guarantees for state banks should be eliminated, the interest rates paid by German firms started to rise, which prompted the need for massive firm restructuring. However, the process has been slow and painful mostly due to Germany's sclerotic labor markets, and as result, the country's economy has been stagnant in the first years of this decade. Japan's experience has been worse. Its economy has barely grown in the last 10 years due to a combination of overly conservative monetary policy and mounting debts by Japanese firms. As Hoshi and Kashyap (2004), Hayashi and Prescott (2002), and Caballero et al. (2003b) argue, it is not firms' debt that explains their inability to recover but the support that Japanese banks have given to grossly underperforming firms (or

"zombies", as they have come to be known). The life support given by mostly insolvent Japanese banks to "zombie" firms can only be explained by a regulatory regime that allows public recapitalization of weak banks and provides overly generous deposit and even creditor and shareholder insurance. Only the shredding of underperforming firms could free the financial and other resources needed by profitable firms to grow and lead the recovery of Japan's economy.

Beyond these country-case examples, in Section 2 of the paper, we present some cross-country evidence that there is a negative relationship between the burden of the regulatory environment and the economy's ability to recover from shocks. In a sample of 76 countries with average data for the 1990s, we find that countries that impose heavier restrictions on product and factor markets (i.e., firm entry, financial transactions, international trade, bankruptcy procedures, bureaucratic red tape, taxation, and labor markets) suffer from more severe—deep and prolonged—recessions. This evidence serves mostly as motivation for the theoretical analysis that is the focus of the study.

This paper analyzes how policy-induced rigidities can impair the economy's ability to absorb and accommodate shocks, producing a more painful and protracted recovery. This is a macroeconomic issue, but it can be properly analyzed only from a microeconomic standpoint. The reason is that policy-induced rigidities affect the dynamics of creation, growth, and destruction of investment projects and firms in a heterogeneous, idiosyncratic manner, even if the shocks are common. Depending on each firm's capital intensity, level of technology, and specific shocks, policy-induced distortions become relevant for some firms and less so for others in the face of common adverse conditions. It is this heterogeneity in firms' responses to shocks that allows us to discern the mechanisms through which rigidities operate.

In order to model the link between slow recoveries and rigidities, we extend the work of Campbell (1998) to allow for policy-induced obstacles to restructuring. Specifically, we develop a dynamic general equilibrium model of heterogeneous plants subject to aggregate and idiosyncratic shocks and rigidities. We model these rigidities as subsidies and taxes that change the relative cost of firm creation, expansion, and survival, thus altering the natural rate of factor reallocation. We then submit the modeled economy to aggregate shocks and compare the recovery path of a distorted economy to that of a fully flexible one.

Ours is a vintage capital model, where different types of capital embody different levels of technology. As the technological frontier expands, capital that represents less advanced technologies will tend to be scrapped. Its salvage value can then be used to produce new capital that embodies the leading-edge technology. In this context, the economy's equilibrium path is characterized by an ongoing process of resource reallocation. When an exogenous rigidity is introduced, such as a production subsidy to incumbent firms, the natural process of entry and exit is muted, reducing the amount of firm restructuring. In this example, the subsidy allows inefficient plants—which would have otherwise exited—to stay longer in business and prevents new and more technologically advanced plants to appear. This promotes an inefficient allocation of resources and pushes the economy inside its production possibilities frontier. We believe these explanations for the lack of recovery and growth apply to a wide range of actual economic experiences.

After presenting the model, we simulate two situations representing particular cases of impediments to reallocation with the purpose of showing how they may affect the

economy's recovery path. In the first numerical exercise, we compare economies that start off with different levels of a production subsidy to incumbent firms. We expose these economies to the same aggregate shock and then compare their recovery paths. Under our benchmark calibration, we find that an undistorted economy that faces a (one-period) transitory aggregate shock equivalent to 5% of steady-state per capita GDP loses about 13% of its pre-shock output and completes restructuring in a period of one quarter. However, in the presence of a similar shock, an economy that starts off with a 5% (10%) subsidy to incumbents loses 14.2% (14.3%) of initial output with a restructuring period of 9 (10) quarters.

In our second exercise, the distortion is a policy response to the aggregate shock. When an exogenous recession hits the economy, jobs are lost and production units are scrapped. To reduce the distress associated to these losses, the government intervenes subsidizing incumbents one period after the shock hits the economy. This intervention is transitory and phased out gradually, lasting about three quarters in the simulation. In this case, an economy that initially imposes a 3% (6%) subsidy to incumbents loses about 24% (36%) of GDP in present value terms with a recovery period that lasts 29 (37) periods. The differences in recovery paths with respect to the fully flexible economy are remarkable, particularly given that we assume that shocks are short-lived and that there is a single distortion present.

Our work builds on the firm heterogeneity models pioneered by Jovanovic (1982) and further extended by Hopenhayn (1992), Ericson and Pakes (1995), and Campbell (1998). This paper complements the analysis started by Caballero and Hammour (1994). In a series of papers, Caballero and Hammour develop a model of inefficient creative destruction, in which transactional difficulties hamper the process of reallocation. They find that in these economies, the processes of firm creation and destruction are decoupled and their rates are inefficiently low. Our analysis differs from that of Caballero and Hammour's in that in our model, rigidities are the result of direct policy interventions. Moreover, we focus on the creation and destruction margins, not attempting to explain the "scrambling" of production units according to their level of efficiency. Our work also complements the studies that analyze the *level* effects of policy distortions in the context of firm dynamics. Hopenhayn and Rogerson (1993) built a model of firm heterogeneity to study the effects of a tax on layoffs. They find large employment and welfare effects on the economy's stationary equilibrium. Similarly, Restuccia and Rogerson (2003) developed a model of firm heterogeneity to show that policies that distort the relative prices faced by individual firms can result in large productivity losses. They use the model to help explain the large differences in aggregate output per capita across countries. Our model is complementary to these analyses because rather than focusing on levels in the steady state, we compare the trajectories of recovery from shocks as represented by transitional dynamics.

Finally, our work is also related to the job reallocation and plant dynamics literature. Davis et al. (1996) and others have extensively documented the international evidence on job reallocation. At any given time, and even within the same industry, jobs are created and destroyed, existing plants expand and contract, new plants start up, and old plants shut down. Given that developing countries face larger shocks, thus requiring higher levels of restructuring than industrialized economies, we should then observe higher rates of reallocation in developing economies. However, the facts documented in the literature show surprisingly similar rates of job reallocation across countries. One reading of this

evidence is that some developing economies face severe obstacles, whether structural or policy-induced, to reshuffle resources across production units. Caballero et al. (2003a) reached a similar conclusion after comparing the degree of labor market inflexibility in several Latin American countries, finding for instance that Mexico faces more rigidities than Chile.

The paper is organized as follows. The following section provides some cross-country empirical support for a link between the regulatory environment and the severity of recessions. In Section 3, we present a model with heterogeneous plants and policy distortions. We explain the mechanics of the model and describe its equilibrium solution. In Section 4, we calibrate and simulate our model economy to quantify the impact of policy distortions on slow recoveries. Section 5 concludes.

2. Some empirical evidence

Our goal is to understand why some countries suffer to recover from temporary negative shocks. To this macroeconomic question, we postulate a microeconomic answer related to the negative effect that distortionary government-imposed regulations have on firm dynamics. That is, an excessive regulatory environment can weaken the process of destruction of inefficient investment projects and the adoption of improved technologies. Given the crucial role that regulations play in our explanation, a necessary first step is to examine whether the regulatory environment is in practice related to the severity of recessions. Here, we illustrate the relevance of this relationship from a cross-country perspective.

The regulatory environment affects the entry, growth, and exit of firms and investment projects. According to this criterion, we can identify and attempt to measure the most relevant aspects of the regulatory regime. Using a variety of cross-country sources, we collected comparable data on the following types of government-imposed regulations in each country for the 1990s: financial restrictions, trade barriers, firm entry costs, inefficient

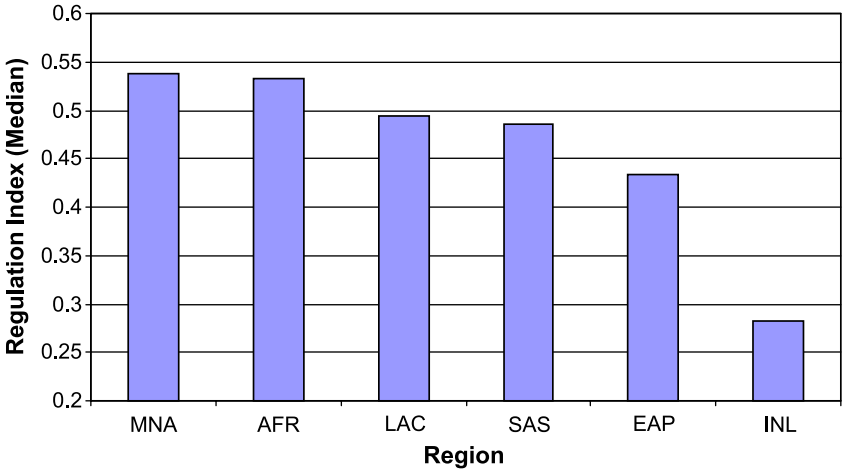

Fig. 1. Regulation index by region.

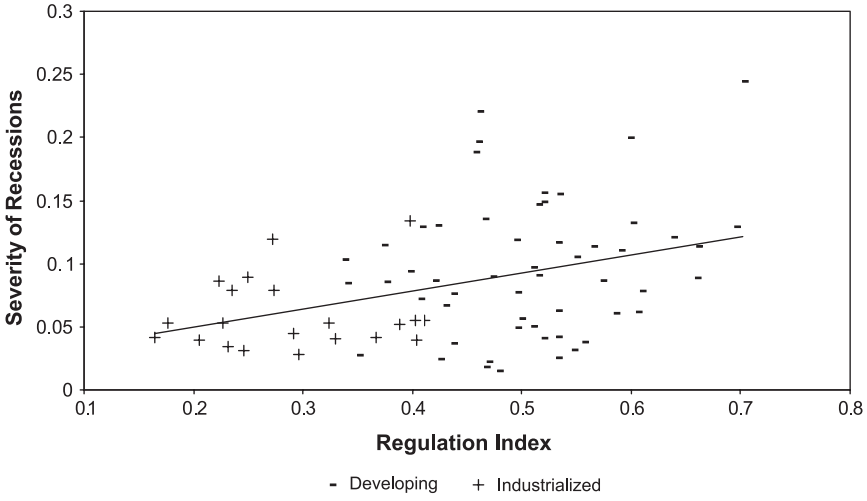

Fig. 2. Severity of recessions and regulatory burden.

bankruptcy procedures, bureaucratic red tape, tax burden, and labor regulations.[1] Given that our purpose here is to illustrate the regulatory regime's overall, reduced-form effect, we combine these regulation measures into a single index. Specifically, we first standardize the indicators to range between 0 and 1—where a higher number indicates a heavier burden of the corresponding regulation—and then we average them out to obtain a single index. Our sample consists of 76 countries, representing all major regions of the world. To get a sense for the prevalence of regulations across regions, Fig. 1 presents the median of the regulatory index for various groups of countries. We can discern three levels of regulatory burden. Sub-Saharan Africa (AFR), the Middle East and North Africa (MNA), Latin America (LAC), and South Asia (SAS) have the highest level of regulatory burden. East Asia and the Pacific (EAP) is in the middle of the range, and industrialized countries (INL) show the lowest level of overall regulations.[2]

The dependent variable in our analysis is the severity of recessions. There is no standard measure in the literature for this concept, but here we propose a simple indicator. It captures the extent of downward output deviations from trend for each country during a given period. We first obtain output-gap series by detrending each country's (log) of per capita GDP, using annual data for the period 1960–2000. The detrending procedure is conducted using the band-pass filter of Baxter and King (1999) on a country-by-country basis. We then identify and select only output gaps *below* trend. Finally, the severity-of-recessions indicator for each country results from adding up its recessionary gaps during the period 1990–2000.

The scatter plot in Fig. 2 represents the simple relationship between the regulation index and the severity of recessions. Confirming our priors, stronger regulations are

[1] See the appendix for specific definitions, sources, and coverage of the data.

[2] We should note that this pattern is not homogeneous across types of regulations. For instance, contrary to the overall index, industrialized countries have the highest burden of taxation.

related to more severe recessions, with a correlation coefficient of 0.36. A more formal evaluation of the connection between our variables of interest should take into account the additional determinants of the severity of recessions. In particular, it is necessary to control for key shocks that can affect the economy and its downward cycles. In particular, we consider the possibility that the severity of recessions is not only related to regulations but also to the volatility of the terms of trade, the volatility of domestic price inflation, and the degree of real exchange rate overvaluation. The first column of Table 1 presents the OLS regression results. The estimated coefficient on the regulation index is positive and statistically significant.

The OLS estimation results do not control for the possibility that the regulatory burden be endogenously determined, along with the severity of recessions. Given that we are interested in the effect from regulations to recessions, we use an instrumental variable procedure to isolate the impact of exogenous changes in the regulation index. We select the instrumental variables from the recent literature on the causes of regulations (see Botero et al. 2003 and Bolaky and Freund 2004). They are the initial level of per capita GDP and variables that indicate legal origin (British, French, German, Nordic) and degree of Western influence in the country. The IV regression results are presented in the second column of Table 1. Hansen's *J*-test of overidentifying restrictions cannot reject the null hypothesis that the instruments are not correlated with the regression residual. Moreover, the instruments have a large explanatory power over the regulatory index (R^2=0.74). Together, these results indicate that the instruments are valid and relevant. Interestingly,

Table 1
Severity of recessions and the burden of regulations (sample: 76 countries, 1990–2000)

	OLS [1]	IV [2]
Dependent variable		
Regulation index	0.09845	0.10021
(index ranges from 0 to 1, with higher meaning more regulated)	2.54	2.18
Control variables		
Volatility of terms of trade shocks	0.00089	0.00087
(standard deviation of annual terms of trade growth)	0.77	0.74
Volatility of domestic inflation	0.00046	0.00045
(standard deviation of annual CPI growth)	1.56	1.59
Real exchange rate overvaluation	0.01203	0.01213
(proportional index, where overvaluation if index>100)	0.85	0.89
R-squared	0.19	0.19
R-squared 1st stage (partial due to excluded instruments)		0.74
SPECIFICATION TEST		
Hansen's *J*-test of overidentifying restrictions (*P* value)		0.93

Severity of recessions–sum of (log) per capita output gap below trend over 1990–2000.
a) Standard errors are robust to heteroscedasticity (Newey-West).
b) *t*-Statistics are presented below the corresponding coefficient.
c) Intercept is included in all estimations but not reported.
d) Instruments: log of per capita GDP in 1990, binary variables indicating legal origin (British, French, German, Nordic), variables indicating fraction of population that speaks a major European language.
Source: Authors' estimation.

the IV estimated coefficient on the regulation index is quite close to its OLS counterpart in terms of sign, size, and statistical significance.

We can use the IV results to gauge a sense for the economic significance of the effect of regulations on the severity of recessions. A simple exercise is to measure the impact of reducing the regulation index from the heaviest to the least regulated regions. In particular, consider reducing the regulation index from that of a typical or median country in Africa, Middle East, Latin America, and South Asia (0.51) to that of the median in developed countries (0.28). Using the IV point estimate for the coefficient on the regulation index (0.1), this reduction in the regulatory burden leads to lessening the severity of recessions by 2.3 percentage points, which represents almost 30% of the typical loss due to recessions in developing countries.

3. A theory of plant selection

We develop a general equilibrium model of heterogeneous production units or "plants", vintage capital, and common and idiosyncratic shocks, based on Hopenhayn (1992) and Campbell (1998). Assume that there exists a distribution of plants characterized by different levels of productivity. In each period, plant managers decide whether to exit or stay in business. If a plant stays, the manager must decide how much labor to hire. If the plant exits, it is worth a sell-off value. New technologies are developed every period. Plants face three types of productivity shocks: an aggregate shock common to all plants, an idiosyncratic (plant-specific) shock, and an innovation to the leading-edge production technology.

In this context, the economy is characterized by an ongoing process of plant entry and exit, with the corresponding job creation and destruction. Plants exit if aggregate economic prospects loom negative. They may also exit if their current technology becomes obsolete, and by selling their capital off, owners gain access to the leading-edge technology—Schumpeter's process of creative destruction. However, exiting is costly as capital loses some of its value in the process. These investment irreversibilities, as modeled by Caballero and Engel (1999), combined with idiosyncratic uncertainty, generate an equilibrium solution where plant owners rationally delay their exit decisions.

Our model extends Campbell's (1998) analysis in three dimensions. First, by fully characterizing plant-level dynamics, we consider starting and closing plants, as well as incumbents. This allows us to look not only at plant entry and exit but also at labor creation and destruction resulting from continuing plants.

Second, we consider both aggregate and idiosyncratic productivity shocks. Within this setting, plants can become more productive over time for two reasons: either they are all exposed to better methods of production or some receive a good realization of productivity improvement while others do not. The distinction is relevant because these nonmutually exclusive ways of increasing productivity have different implications. In particular, while aggregate productivity changes are unbounded and do not necessarily entail substantial worker displacement, the increase in efficiency resulting from specific shocks is bounded by the production possibilities frontier and may involve significant reallocation of inputs across firms. Moreover, while the former predicts a negative correlation between entry and

exit of plants (and corresponding labor creation and destruction), the latter implies positive comovement between them.

Finally, we extend Campbell's model to allow for exogenously imposed rigidities. In particular, we study the effect of policies that alter firms' decisions to leave or stay in the market. In our benchmark simulations, markets are fully flexible. Thus, policies that alter the equilibrium reduce welfare. In particular, policies that subsidize incumbents reduce the reallocation of resources that naturally follows a recession, delaying recovery. Governments are willing to impose such policies to reduce the volatility and short-run social and political costs associated to recessions. Our simulation results below are consistent with this fact: as the reallocation process is muted, incumbent protection reduces short-run output losses at the cost of a slow recovery.

In order to better relate our model to the existing microdynamics literature, we refer to production units as "plants". We should make clear, however, that we do not provide a theory of the firm or the plant. In our model, the size of the firm as a collection of production units is indeterminate, and therefore, the modeled entry–exit dynamics can occur either within or across *actual* firms or plants. Nevertheless, to the extent that firm or plant activities tend to consist of interrelated production units (or investment projects), we expect that there is a considerable correlation between production dynamics in the model and plant dynamics in reality. Moreover, we conjecture that the magnitude of entry and exit implicit in the model is an upper bound of those in reality. We come back to this point when we discuss the parameterization of the model.

The gap between the definition of production units in the model and in the data implies that our model abstracts from reality in other dimensions that are also relevant for the specification of parameters as well as for the interpretation of our results. On the one hand, only new plants invest. In the data, investment is carried out by both new and old plants. On the other hand, plants may adopt new technologies without actually closing.

In what follows we describe our model in detail.

3.1. The model economy

The economy is populated by a continuum of heterogeneous plants. A plant needs labor (n) and capital (k) for production of the unique good, which can be used for consumption or investment. This unique production good is the numeraire.

Each plant's technology is given by

$$y_t = e^{\lambda_t} n_t^{\alpha} \left(e^{\theta_t} k_t\right)^{1-\alpha}$$

where λ_t is the aggregate productivity shock common to all establishments and θ_t is the idiosyncratic productivity shock. The aggregate productivity shock follows an AR(1) process described by

$$\lambda_{t+1} = \rho_\lambda \lambda_t + \varepsilon_{t+1}^{\lambda}, \varepsilon_{t+1}^{\lambda} \sim N\left(0, \sigma_\lambda^2\right)$$

$N(\cdot)$ is the normal distribution, $0 \leq \rho_\lambda \leq 1$, and ε_t^{λ} is *i.i.d.*

Each type of capital embodies different levels of technology. Because technologies are characterized by constant returns to scale, we can restrict the size of all plants to be equal

to one unit of capital. Thus, capital goods are identified with plants so that investing one unit of the aggregate good yields a unit mass of plants.

The aggregate production function of this model economy is:

$$Y_t = e^{\lambda_t} N_t^{\alpha} \left[\int_{-\infty}^{\infty} e^{\theta_t} k_t(\theta) d\theta \right]^{1-\alpha} = e^{\lambda_t} N_t^{\alpha} \bar{K}_t^{1-\alpha}$$

where $\bar{K}_t = \int_{-\infty}^{\infty} e^{\theta_t} k_t(\theta) d\theta$ is the aggregate effective capital stock.

Capital embodying relatively low level of technology is scrapped as its productivity lags behind that of the leading-edge technology. When a plant is retired, a unit of capital that is scrapped has salvage value $s<1$. The total amount of salvaged capital in period t is then

$$S_t = (1-\delta) s \int_{-\infty}^{\bar{\theta}_t} k_t(\theta_t) d\theta_t$$

where $\bar{\theta}_t$ is the endogenous cut-off level of productivity that determines the exit decision of plants. Units of the production goods not consumed—which are made up of investment and part of last period's scrapped capital—are transformed into new units of capital embodied with the leading-edge technology. That is, the initial productivity level of a plant born in period t is a random variable with a normal distribution $\theta_{t+1} \sim N(z_t, \sigma^2)$, where z_t is the index of embodied technology that represents the leading-edge production process. This random variable follows a random walk with a positive drift μ_z according to

$$z_{t+1} = \mu_z + z_t + \varepsilon_{t+1}^z, \varepsilon_{t+1}^z \sim N\left(0, \sigma_z^2\right).$$

This drift is the only source of long-run aggregate growth in our economy.

Capital that is not scrapped receives an idiosyncratic shock to its productivity level before the next period production process starts, according to

$$\theta_{t+1} = \theta_t + \varepsilon_{t+1}^{\theta}, \varepsilon_{t+1}^{\theta} \sim N\left(0, \sigma_{\theta}^2\right)$$

This idiosyncratic shock has zero mean, and thus, it does not affect the economy's long-run growth rate. The random walk property of the stochastic process ensures that the differences in average productivity across units of capital persist over time. Thus, at any t, the units of capital with more advanced technology have a lower probability of shutting down.

Summarizing, there are three sources of uncertainty: first, an idiosyncratic productivity shock, ε_t^{θ}, that determines the plant-level decisions of incumbents. This shock does not alter the aggregate equilibrium allocation. Second, an idiosyncratic productivity shock, ε_t^z, that governs the economy-wide growth. Notice that plants, as they decide to stay or leave, choose between the following distributions:

$$\theta_{t+1} \sim N\left(\theta_t, \sigma_{\theta}^2\right)$$

$$\theta_{t+1} \sim N\left(z_t, \sigma^2\right)$$

Finally, an aggregate shock, ε_t^{λ}, which introduces aggregate uncertainty, moves the economy's production possibility frontier transitorily.

Plants last one period. At the beginning of the period, firms decide production and hiring. The wage rate in period t is ω_t, and the beginning and end of period prices of a plant with productivity θ_t are $q_t^0(\theta_t)$ and $q_t^1(\theta_t)$, respectively. Within this setting, given the number of units of capital with productivity θ_t, $k_t(\theta_t)$, the employment assigned to each plant is given by

$$n_t(\theta_t) = N_t^{\alpha} e^{\theta_t} / \bar{K}_t$$

After production, firms decide which plants should be scrapped and which ones should be maintained in business. Firms sell their production and salvaged capital to the consumer and to a construction firm that produces capital embodying the leading-edge technology.

Capital evolves according to the law of motion

$$k_{t+1}^0(\theta_{t+1}) = \int_{-\infty}^{\infty} \frac{1}{\sigma_\theta} \phi\left(\frac{\theta_{t+1} - \theta_t}{\sigma_\theta}\right) k_t^1(\theta_t) d\theta_t + \phi\left(\frac{\theta_{t+1} - z_t}{\sigma}\right) I_t^c$$

Because asset prices equal discounted expected dividend streams, increases in the level of productivity raise these prices, and because the scrap value of a plant is independent of its productivity, only plants with productivity levels below the threshold $\bar{\theta}_t$ exit the market. The marginal plant, that is, the one with productivity level $\bar{\theta}_t$, has a market value given by the scrap value. The following equation states this condition.

$$s = q_t^1(\bar{\theta}_t)$$

Finally, the purchasing price of a unit of capital is determined not only by its marginal productivity but also by the price at which the capital left after depreciation may be sold at the end of the period. Thus, for each θ_t, the purchase and sale decisions of capital units must be characterized by the zero profit condition:

$$q_t^0(\theta_t) = (1-\alpha)\left(\frac{\bar{K}_t}{N_t}\right)^{-\alpha} e^{\theta_t} + (1-\delta)\left[1\{\theta_t < \bar{\theta}_t\} s + 1\{\theta_t \geq \bar{\theta}_t\} q_t^1(\theta_t)\right]$$

where $1\{\cdot\}$ is an indicator function that equals 1 if its argument is true and 0 otherwise. This condition restricts the beginning of period price to be the return from using the capital plus the price at which it can be sold at the end of the period.

There is a construction firm whose sole purpose is to incorporate the leading-edge technology into the goods produced by the firm. A construction firm which buys I_t^c units of the aggregate good from the producer incorporates the leading-edge technology at zero cost, and then sells it to consumers at the end of the period at a price per unit q_t^{1i}. Profit maximization requires the price of the construction project to be equal to the cost of inputs. That is,

$$q_t^{1i} = 1.$$

Government subsidies—or taxes—τ_t, follow an AR(1) process as the one described for the aggregate productivity shock, λ_t. We consider policies that allow plants to stay longer in the market than they would have without government intervention. We represent them by a subsidy to incumbents that increases the end of period price of an old plant. The

government's budget constraint is guaranteed to be satisfied by imposing a lump-sum transfer to consumers.

The remainder of the model is standard. There is a continuum of identical infinitely lived consumers who own labor and equity. Their preferences are given by

$$E_0\left[\sum_{t=0}^{\infty}\beta^t(\log(c_t)+\gamma(1-n_t))\right]$$

where c_t and $1-n_t$ are consumption and leisure, respectively, and $\beta\in(0,1)$ is the subjective time discount factor. Every period, consumers have a time endowment equal to 1. Following Hansen (1985) and Rogerson (1988), we assume that consumers can work a fixed number of hours or none at all. To avoid nonconvexities, consumers are assumed to trade employment lotteries. As a consequence, n_t is interpreted as the fraction of the population that works.

3.2. Definition of the equilibrium

A *competitive equilibrium* in this economy is a set of contingent plans $\{c_t, I_t, Y_t, \bar{K}_t, N_t, S_t\}_{t=0}^{\infty}$ and contingent prices $\{\omega_t, q_t^1, q_t^0, q_t^{1i}\}_{t=0}^{\infty}$ of labor, plants at the beginning of the period, plants at the end of the period, and construction projects, and a vector $\{\bar{\theta}_t\}_{t=0}^{\infty}$, such that, given contingent prices, the transfer T_t, and production and government stochastic processes $\{z_t, \theta_t, \lambda_t, \tau_t\}$ at each period t:

(1) The representative consumer solves

$$E_0\left[\sum_{t=0}^{\infty}\beta^t(\log(c_t)+\gamma(1-n_t))\right]$$

$$c_t + I_t^c q_t^{1i} + (1-\tau_t)\int_{-\infty}^{\infty} q_t^1(\theta_t)k_t^1(\theta_t)d\theta = \omega_t n_t + \int_{-\infty}^{\infty} q_t^0(\theta_t)k_t^0(\theta_t)d\theta - T_t$$

$$k_{t+1}^0(\theta_{t+1}) = \int_{-\infty}^{\infty}\frac{1}{\sigma_\theta}\phi\left(\frac{\theta_{t+1}-\theta_t}{\sigma_\theta}\right)k_t^1(\theta_t)d\theta_t + \phi\left(\frac{\theta_{t+1}-z_t}{\sigma}\right)I_t^c$$

(2) The producer of the consumption good satisfies

$$n_t(\theta) = N_t^{\alpha}e^{\theta_t}/\bar{K}_t$$

$$\omega_t = \alpha e^{\lambda_t}\left(\frac{\bar{K}_t}{N_t}\right)^{1-\alpha}$$

$$q_t^1(\bar{\theta}_t) = s$$

$$q_t^0(\theta_t) = (1-\alpha)\left(\frac{\bar{K}_t}{N_t}\right)^{-\alpha}e^{\theta_t} + (1-\delta)\left[1\{\theta_t<\bar{\theta}_t\}s + 1\{\theta_t\geq\bar{\theta}_t\}q_t^1(\theta_t)\right]$$

(3) The intermediary satisfies

$$I_t^i = q_t^{1i} I_t^c$$

(4) The government satisfies

$$\tau_t \int_{-\infty}^{\infty} q_t^1(\theta_t) k_t^1(\theta_t) d\theta = T_t$$

(5) The market clearing restriction is satisfied

$$c_t + I_t = Y_t + S_t$$

4. A numerical evaluation

We simulate the transitional path that follows aggregate productivity shocks. We study slow recoveries resulting from distortions that alter plants dynamics. Although these distortions may take various forms, we model a specific policy that subsidizes incumbents. Plants that would have exited after the shock stay longer in the market when the subsidy is positive. To approximate actual experiences, we simulate equilibria for a range of policy values.

4.1. Solution method

To solve for the numerical equilibria we use a three-step strategy. First, we compute the nonstochastic steady-state values for the model variables. Second, we linearize the system of equations that characterizes the solution around the long-run values of the variables. Third, we apply the method of undetermined coefficients described in Christiano (1998). To solve the model, we scale the variables by the long-run growth rate such that they converge to a steady state. Then, a mapping takes the solution from the scaled objects solved for in the computations to the unscaled objects of interest.

4.2. Parameter values

We can separate the parameters in three types, given by the following vectors: aggregate parameters $\{\beta, \delta, \gamma, \mu_z, \alpha, s, \sigma_\lambda, \rho_\lambda\}$; plant-specific parameters $\{\sigma, \sigma_\theta\}$; and policy parameters $\{\tau, \sigma_\tau, \rho_\tau\}$.

The aggregate parameters are calibrated as in a representative firm economy. A period is one quarter. Long-run growth is given by $\mu_z(1-\alpha)/\alpha$, which also represents the growth rate of income per capita because population is stationary. Thus, to have an annual trend growth rate of 2%, and given α equal to 0.6—a standard value in the literature—we use μ_z equal to 0.52%. The marginal utility of leisure, γ, determines the fraction of available time allocated to labor. We chose γ consistently with N equal to 0.35. The irreversibility s is fixed in 0.9. The remaining aggregate parameters, β, α, and δ, are chosen as in the standard growth literature.

Plant-specific parameters are taken from Campbell (1998). There are two reasons to do so. First, long series of plant-level data are generally not available for a large sample of countries. Second, we see our economies as equal in all respect but policy. We use the United States as our undistorted long-run benchmark.

Campbell (1998) sets parameter values to match the moments of plant dynamics using data from the Annual Survey of Manufactures of the U.S. Department of Census. Although we refer to production units as plants in our model, investment projects provide a better description of them. Thus, an entry or an exit in the model might occur within an actual plant and thus might not be captured by actual data. In this sense, our model naturally generates much more dynamics than that observed in the data. Nevertheless, our parameterization underestimates the true variance of investment projects, as we match our model's moments using plant-level data. Had we used the variability of entry and exit of projects across *and within* plants, our results would have assigned a much larger role to reallocation and restructuring as a source of transitional growth.

Policy parameters are also complicated to calibrate because comparable series for plant-level distortions are typically not available across countries. Thus, we approximate different actual experiences by simulating transitional growth using a wide range of policy values. These distortions are intended to capture different regulations that reduce competition, raise the costs of firm formation, and slow down technological adoption. They may also represent other impediments to the natural process of reallocation across firms such as financial market imperfections. In general, any policy that affects current and expected productivity, interfering with the natural process of birth, growth, and death of firms, will have a detrimental effect on aggregate growth. For instance, as the cost of entering and exiting the economy changes, the distribution of firms is altered: too many inefficient firms remain in the market and too few efficient firms enter the market. As a result, both the reshuffling of resources from less to more efficient firms and the adoption of the leading-edge technology are impeded. Our choices for the level of the subsidy yield a government size between 18.2% and 23.7% in steady state. These figures are at ranges within the lower bound of the distribution of actual government shares in GDP (OECD 2003).

Finally, the remaining parameters, σ_λ, ρ_λ, σ_τ, and ρ_τ, are picked along with our simulation exercises; i.e., they are used to fix the size and persistence of the shocks imposed on our simulated economies. Table 2 summarizes our parameter choices.

4.3. Simulating transitional growth

Our benchmark equilibrium is given by an economy without distortions that faces an exogenous 5% reduction in its aggregate productivity level (i.e., σ_λ=−0.05). This shock has no persistence (i.e., ρ_λ=0) and thus it lasts only one period. We make the latter assumption to abstract from the intertemporal effects of the shock.

Fig. 3 shows the impulse responses for four key macroeconomic elements of the benchmark equilibrium: output, consumption, investment, and hours worked. We see that, as expected, a negative aggregate shock to productivity reduces all of them. These impulse responses are consistent with those observed in a representative firm economy. A model with plant heterogeneity introduces an additional margin by allowing entry and exit and reshuffling of resources across existing plants. These reallocation effects are relevant for

Table 2
Parameterization

Aggregate parameters		
Discount factor	β	0.98
Fraction of hours worked in steady state	N	0.35
Labor share	α	0.6
Technology drift	μ_z	0.0052
Irreversibility	S	0.9
Depreciation rate	δ	0.02
Plant-level parameters		
Standard deviation of shock to incumbents	σ_θ	0.03
Standard deviation of shock to startups	σ	0.25
Simulation parameters		
Aggregate productivity shock	σ_λ	−0.05
Aggregate productivity shock persistence	ρ_λ	0
Policy level	τ	
Exercise 1		−0.05, −0.1
Exercise 2		0
Policy shock	σ_τ	
Exercise 1		0
Exercise 2		−0.06,−0.03
Policy shock persistence	ρ_τ	
Exercise 1		n.a.
Exercise 2		0.66

aggregate productivity dynamics. Figs. 4 and 5 show impulse responses for the cut-off level of productivity that determines endogenous exit decisions and job creation and destruction rates, respectively. A one-period reduction in the level of aggregate productivity increases the cut-off level of productivity because it forces relatively inefficient plants to exit. Moreover, job creation falls and job destruction increases. The aggregate labor response is the net result of these two margins of adjustment.

To study differences in recovery paths, we analyze two particular cases of impediments to reallocation that might shed light on actual differences in recovery paths. In the first numerical exercise, we compare economies that start off with different levels of a production subsidy to incumbent firms. We then expose these economies to the same 5% aggregate shock and compare their recovery paths to their own trend. The second exercise simulates an economy with no distortions that imposes a transitory subsidy to incumbents a period after the aggregate shock occurs. When the exogenous recession hits the economy, jobs are lost and production units are scrapped. To reduce the distress associated to these losses, the government intervenes subsidizing incumbents one period after the shock hits the economy. This policy is short lived, as it follows an AR(1) with an autocorrelation coefficient of 0.66; that is, it lasts about three quarters.[3]

[3] Our exercise is highly stylized because the endogeneous policy response is more likely to happen in reality when aggregate shocks are persistent.

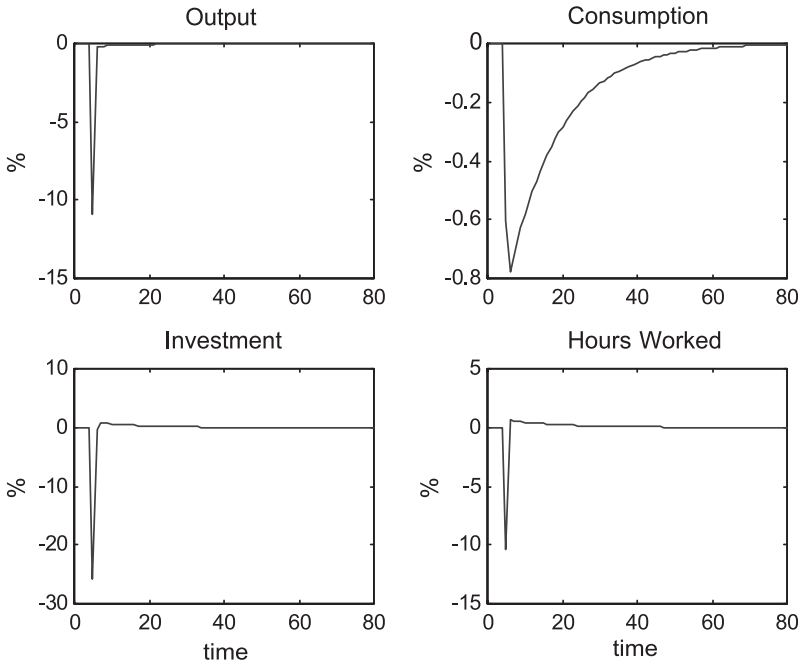

Fig. 3. Impulse response for macro variables.

Fig. 6 shows the recovery path for our first exercise. The trend has been normalized to one in both economies. Initially, the economy that protects incumbents experiments a smaller fall in output. This is precisely why this type of policies is typically implemented: to reduce volatility. Over time, however, the protected economy experiments a slow

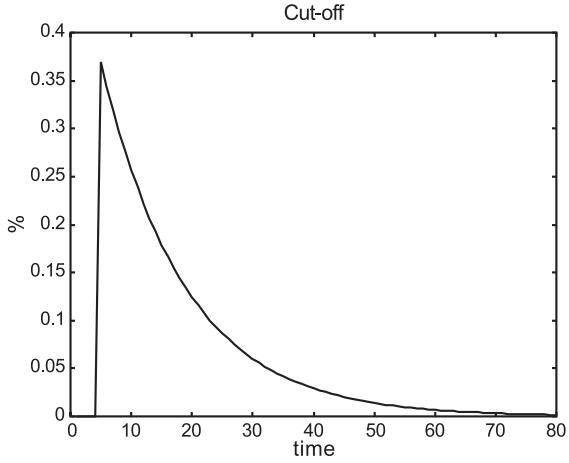

Fig. 4. Impulse response for cut-off level.

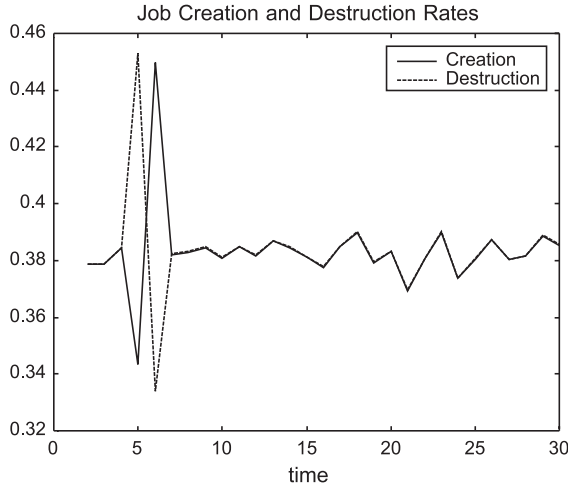

Fig. 5. Impulse response for job creation and destruction rates.

recovery. The results are similar in the second exercise. Fig. 7 shows the recovery path in this case. As before, the economy that subsidizes existing plants experiences stagnating growth and recovers its pre-crisis output trend level much later.

To measure the differences in the recovery paths of the undistorted and distorted economies, we provide two types of indicators. The first type relates to the size of output losses, whereas the second to the time that output takes to recover its long-run trend.

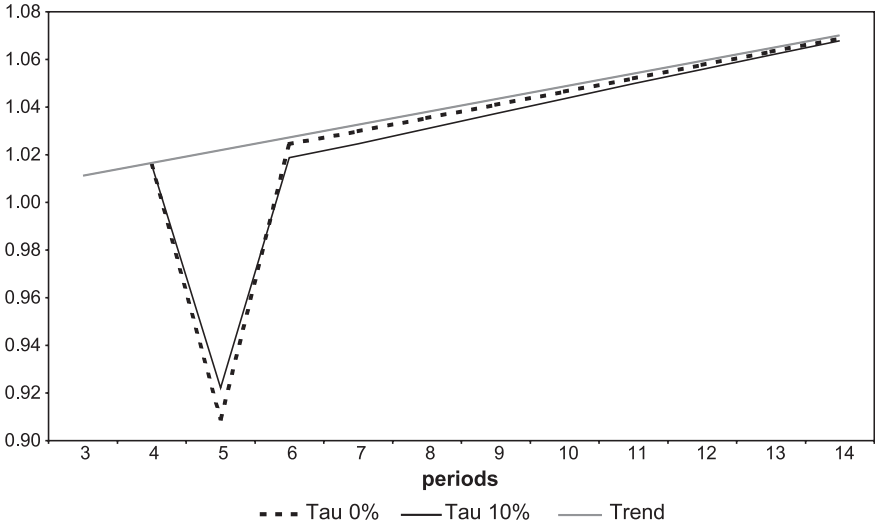

Fig. 6. Slow recovery–Exercise 1 (normalized output level).

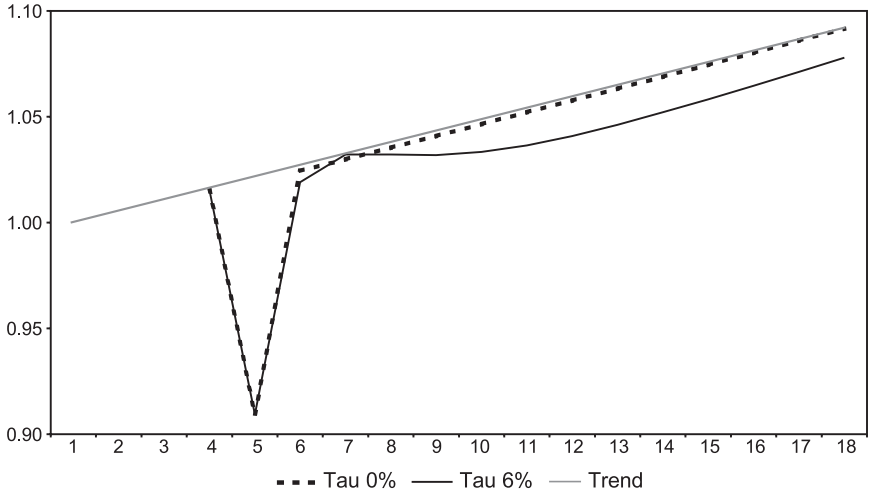

Fig. 7. Slow recovery–Exercise 2 (normalized output level).

To construct the first indicator (from now on, the loss), we start by normalizing the path of output and its trend in such a way that all economies start off with the same level of output; that is, GDP per capita and its trend at time $t=0$ are all equal to 1. We do this to account for the fact that distorted economies have lower output in steady state. Let Y_t^τ represent the actual GDP of the economy with distortion at level τ in period t, and let YT_t^τ be its trend. Thus, the loss is the present value of output deviations from its trend as a fraction of pre-shock output:

$$\frac{\sum_{t=0}^{T} \beta^t (Y_t^\tau - YT_t^\tau)}{Y_0^\tau}$$

We use two sets of recovery length indicators. The first one measures the time it takes the economy to recover its trend after the economy is struck by the exogenous aggregate shock. The second indicator is the fraction of the loss that is realized in a given number of quarters.

Table 3 reports these indicators for the simulated economies. The fully flexible economy loses a significant fraction of its pre-crisis GDP over the recovery path: 13.1% in present value terms. The economy does not recover instantaneously because there exist technological rigidities—a scrap value below 1 and a lag between investment decisions and its availability for production. These rigidities imply that the loss of output is larger than the actual shock. If the economy is already distorted when the shock strikes, the loss increases to slightly over 14%. This difference, about a 1% of pre-crisis GDP, is totally due to reduced reallocation and thus to lower aggregate TFP growth. Recall that we measure the loss after normalizing the path of output, so the loss does not incorporate the fact that the distorted economy is poorer in steady state. This additional loss is large. The measured losses associated to the subsidy that is given right after the crisis starts are much larger

Table 3
Simulated slow reocovery indicators

Preexisting distortion				
		Subsidy (%)		
		0	5	10
Loss (% of pre-shock GDP)		13.1	14.2	14.3
Catching up with the trend (quarters)	0.2%	1	9	10
	0.5%	1	2	4
% of the loss realized in	1 quarter	84.2	72.3	68.1
	5 quarters	91.1	88.7	90.1
	10 quarters	94.5	94.9	96.5
	20 quarters	97.8	98.9	99.6
	30 quarters	99.1	99.8	100.0
Distortion along the way				
		Subsidy (%)		
		0	3	6
Loss (% of pre-shock GDP)		13.1	23.7	36.3
Catching up with the trend (quarters)	0.2%	1	29	37
	0.5%	1	17	26
% of the loss realized in	1 quarter	84.2	46.4	30.3
	5 quarters	91.1	57.2	43.6
	10 quarters	94.5	71.9	63.5
	20 quarters	97.8	88.9	86.0
	30 quarters	99.1	95.6	94.6

(first line of the second panel.) Their larger size is due to the fact that the tax puts the economy below its trend for a long period of time (see Fig. 7).

The second measure shows that the undistorted economy quickly recovers its output trend: it takes only one quarter to reduce the gap to less than one fifth of 1%.[4] The subsidized economies take 9 and 10 quarters, respectively. The length of the recovery period increases substantially when the government subsidizes firms right after the crisis has started, with catch-up periods that rise over 30 quarters. Thus, the policy intervention reduces volatility and firm destruction at the cost of a long period of stagnation.

Our final measure, the fraction of the loss that is realized in 1, 5, 10, 20, and 30 quarters is reported at the bottom of each panel. Most of the loss is quickly realized in the fully flexible economy, with over 84% of it happening within the first period. Subsidized economies spread these losses over time, with 68% to 72% realized within the first quarter. Only after 10 quarters do all three simulated economies behave similarly, having realized about 95% of the loss. Once again, the differences with the economy that is intervened during the crisis are striking: only 30% to 46% of the loss is realized within the first quarter, spreading the recovery path over a much longer

[4] The size of this lag depends crucially on our one quarter time-to-build assumption.

period of time. The economy takes about 30 quarters to realize 95% of the loss, i.e., 5 years more than the undistorted economy.

Our results show that the costs associated to incumbent protection are substantial, both in terms of lost output and recovery length. These costs are much larger whenever the economy is distorted along the recovery path because within a short period of time, the economy faces two shocks: the exogenous aggregate shock and the policy response to the shock. If the government lets the economy adjust on its own, the initial fall in output is much sharper but concentrated over a significantly shorter period of time.

5. Conclusions

In this paper, we have linked microeconomic rigidities to aggregate transitional growth. By subsidizing incumbents, we have altered the reallocation process, a key source of aggregate efficiency. As plants that would have exited the economy stay longer in the market, aggregate efficiency lowers and growth stagnates. As a result, economies experience slow recoveries and large output losses.

Our findings are consistent with observed recovery paths. The evidence on plant dynamics across countries is also consistent with our findings. Developing and developed economies show surprisingly similar rates of job reallocation, although output volatility is markedly higher in poor countries. This high volatililty suggests the need for higher restructuring. Thus, the evidence is consistent with sluggish restructuring in developing countries, perhaps as a result of institutional impediments to resource mobility across production units. Governments are willing to impose these rigidities to reduce the deepness of recessions and the associated short-run social and political costs. However, reduced volatility comes at the cost of stagnation and increased output losses in the long run.

Finally, our results suggest further research on other growth-related issues. Market-oriented reforms have been ubiquitously undertaken during the last two decades. However, most reforms are implemented sequentially, so when one reform is undertaken, other obstacles to reallocation stay in place. Our results suggest that the benefits from liberalizing international trade or from privatizing publicly owned firms will be largely reduced if impediments to plant dynamics are not eliminated simultaneously.

Acknowledgements

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Appendix A. Definitions and sources of the components of the index on regulatory burden

Variable name in corresponding database (name in our database)	Scale	Description	Years	Sources
Entry				
Number of procedures (db_entry_proc)	Actual number	The number of different procedures that a start-up has to comply with in order to obtain a legal status, i.e., to start operating as a legal entity. The data cover (1) procedures that are always required; (2) procedures that are generally required but that can be avoided in exceptional cases or for exceptional types of businesses.	Survey conducted in 1999, updated to 2003	Doing Business–The World Bank Group–Starting a Business, see Djankov, Simeon, Rafael La Porta, Florencio, Lopez-de-Silanes and Andrei Shleifer, "The Regulation of Entry", Quarterly Journal of Economics, 117, 1–37, Feb. 2002. http://rru.worldbank.org/doingbusiness
Number of days (db_entry_days)	Actual number	Time recorded in calendar days. It is assumed that the minimum time required to fulfill a procedural requirement is 1 day. The variable measures the average duration estimated necessary to complete a procedure. The fastest procedure (independent of cost) is chosen. It is assumed that the entrepreneur completes the procedure in the most efficient way, ignoring the time that the entrepreneur spends in information gathering.	Survey conducted in 1999, updated to 2003	

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Appendix A (*continued*)

Entry					
Cost (db_entry_cost)	% GNI		Costs associated with starting up a business, based on the texts of the Company Law, the Commercial Code, or specific regulations. If there are conflicting sources and the laws are not completely clear, the most authoritative source is used. If the sources have the same rank, the source indicating the most costly procedure is used. In the absence of express legal fee schedules, a governmental officer's estimate is taken as an official source. If several sources have different estimates, the median reported value is used. In the absence of a government officer's estimates, estimates of incorporation lawyers are used instead. If these differ, the median reported value is computed. In all cases, the cost estimate excludes bribes.	Survey conducted in 1999, updated to 2003	
Cost (db_entry_cost)					
Entry regulation (ief_regulation)	1	Very low	Existing regulations straightforward and applied uniformly to all businesses; regulations not much of a burden for business; corruption nearly nonexistent.	1995–2003 (annual)	The Index of Economic Freedom-Heritage Foundation Based on: Economist Intelligence Unit, Country Commerce and Country Report, 2001 and 2002; U.S. Department of State, Country Commercial Guide 24 and Country Reports on Economic Policy and Trade Practices for 2000; Office of the U.S. Trade Representative, 2002 National Trade Estimate Report on Foreign Trade Barriers; and official government publications of each country. http://www.heritage.org/research/features/index/index.html
	2	Low	Simple licensing procedures; existing regulations relatively straightforward and applied uniformly most of the time, but burdensome in some instances; corruption possible but rare.		
	3	Moderate	Complicated licensing procedure; regulations impose substantial burden on business; existing regulations may be applied haphazardly and in some instances are not even published by the government; corruption may be present and poses minor burden on businesses.		
	4	High	Government-set production quotas and some state planning; major barriers to opening a business; complicated licensing process; very high fees; bribes sometimes necessary; corruption present and burdensome; regulations impose a great burden on business.		
	5	Very high	Government impedes the creation of new businesses; corruption rampant; regulations applied randomly		

Trade					
Trade (ief_trade)	1	Very low	Weighted average tariff rate less than or equal to 4%.	1995–2003 (annual)	The Index of Economic Freedom–Heritage Foundation, Based on: Economist Intelligence Unit, Country Report and Country Commerce, 2002; International Monetary Fund, Government Finance Statistics Yearbook and International Financial Statistics on CD-ROM, 2002; Office of the U.S. Trade Representative, 2002 National Trade Estimate Report on Foreign Trade Barriers; U.S. Department of State, Country Commercial Guide 3 and Country Reports on Economic Policy and Trade Practices for 2001 and 2002; World Bank, World Development Indicators 2002; World Trade Organization, Trade Policy Reviews, 1995 to June 2001; and official government publications of each country. For all the European Union countries, the authors have based the score on data reported by the World Bank.
	2	Low	Weighted average tariff rate greater than 4% but less than or equal to 9%.		
	3	Moderate	Weighted average tariff rate greater than 9% but less than or equal to 14%.		
	4	High	Weighted average tariff rate greater than 14% but less than or equal to 19%.		
	5	Very high	Weighted average tariff rate greater than 19%.		

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Appendix A (*continued*)

Variable name in corresponding database (name in our database)	Scale		Description	Years	Sources
4. B.i. Hidden import barriers (efw_bi)	0=heavy regulation	0 to 10	No barriers other than published tariffs and quotas.	1995, 2000, and 2001	Economic Freedom of the World–The Fraser Institute From Section 4: Freedom to Exchange with Foreigners; B. Regulatory Trade Barriers Based on: World Economic Forum (2001), *Global Competitiveness Report 2001–2002* (Oxford: Oxford Univ. Press). http://www.freetheworld.com/release.html
4. B.ii. Costs of importing (efw_bii)	0=heavy regulation	0 to 10	The combined effect of import tariffs, license fees, bank fees, and the time required for administrative red tape raises costs of importing equipment by (10=10% or less; 0=more than 50%). This component is based on survey responses to this question obtained from the Global Competitiveness Report 2000.		
Financial markets					
iv. Avoidance of interest rate controls and regulations that lead to negative real interest rates (efw_aiv)	0=heavy regulation	0 to 10	Data on credit-market controls and regulations were used to construct rating intervals. Countries with interest rates determined by the market, stable monetary policy, and positive real deposit and lending rates received higher ratings. When interest rates were determined primarily by market forces and the real rates were positive, countries were given a rating of 10. When interest rates were primarily market-determined but the real rates were sometimes slightly negative (less than 5%) or the differential between the deposit and lending rates was large (8% or more), countries received a rating of 8. When the real deposit or lending rate was persistently negative by a single-digit amount or the differential between them was regulated by the government, countries	1970–2000 (5-year) and 2001	Economic Freedom of the World–The Fraser Institute. 5: Regulation of Credit, Labor, and Business; A. Credit Market Regulations, Based on: International Monetary Fund, International Financial Statistics Yearbook (various issues, as well as the monthly supplements)

			were rated at 6. When the deposit and lending rates were fixed by the government and the real rates were often negative by single-digit amounts, countries were assigned a rating of 4. When the real deposit or lending rate was persistently negative by a double-digit amount, countries received a rating of 2. A 0 rating was assigned when the deposit and lending rates were fixed by the government and real rates were persistently negative by double-digit amounts or hyperinflation had virtually eliminated the credit market.		
v. Interest rate controls: interest rate controls on bank deposits and/or loans are freely determined by the market (GCR) (efw_av)	0=heavy regulation	0 to 10	Data provided by the World Economic Forum.		
Banking and finance (ief_banking)	1	Very low	Government involvement in the financial sector negligible; very few restrictions on foreign financial institutions; banks may engage in all types of financial services.	1995–2003 (annual)	The Index of Economic Freedom–Heritage Foundation, Based on: Economist Intelligence Unit, Country Commerce, Country Profile, and Country Report for 2001 and 2002; U.S. Department of State, Country Commercial Guide 19 ; U.S. Department of State, Country Reports on Economic Policy and Trade Practices for 2001; and official government publications of each country.
	2	Low	Government involvement in the financial sector minimal; few limits on foreign banks; country may maintain some limits on financial services; domestic bank formation may face some barriers.		
	3	Moderate	Substantial government influence on banks; government owns or controls some banks; government controls credit; domestic bank formation may face significant barriers.		
	4	High	Heavy government involvement in the financial sector; banking system in transition; banks tightly controlled by government; possible corruption; domestic bank formation virtually nonexistent.		

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Appendix A (*continued*)

Variable name in corresponding database (name in our database)	Scale		Description	Years	Sources
Financial markets					
Banking and finance (ief_banking)	5	Very high	Financial institutions in chaos; banks operate on primitive basis; most credit controlled by government and goes only to state-owned enterprises; corruption rampant.		
Contract enforcement					
Number of procedures (db_contr_proc)	Actual number		Number of procedures mandated by law or court regulation that demands interaction between the parties or between them and the judge or court officer. The questionnaire covers the step-by-step evolution of a debt recovery case before local courts in the country's most populous city.	Survey conducted in 1999, updated to 2003	Doing Business–The World Bank Group–Contract Enforcement, see Simeon Djankov, Rafael La Porta, Florencio Lopez-de-Silanes, and Andrei Shleifer, "Courts", Quarterly Journal of Economics, May 2003.
Bureaucracy quality (icrg_bureau)	0 to 4		High points are given to countries where the bureaucracy has the strength and expertise to govern without drastic changes in policy or interruptions in government services. Countries that lack the cushioning effect of a strong bureaucracy receive low points because a change in government tends to be traumatic in terms of policy formulation and day-to-day administrative functions.	1990–2000	International Country Risk Guide–PRS Group http://www.prsgroup.com/icrg/icrg.html
Fiscal burden					
Fiscal burden (ief_taxation)	1	Very low	*Individual income tax grading scale* Top income tax rate 0%. Marginal rate for the average taxpayer 0%.	1995–2003 (annual)	The Index of Economic Freedom–Heritage Foundation Based on: Ernst & Young,

2	Low	Top income tax rate greater than 0% and less than or equal to 25%. Marginal rate for the average taxpayer greater than 0% and less than or equal to 10%.	2002 The Global Executive and 2002 Worldwide Corporate Tax Guide; International Monetary Fund Staff Country Report, Selected Issues and Statistical Appendix, 2000 to 2002; Economist Intelligence Unit, Country Commerce, Country Profile, and Country Report for 2001 and 2002; U.S. Department of State, Country Commercial Guide 9; and official government publications of each country. Sources other than Ernst & Young are noted in the text. For information on government expenditures, the authors' primary sources were Organisation for Economic Cooperation and Development data (for member countries); International Monetary Fund, Government Finance Statistics Yearbook for 2001, and International Monetary Fund Staff Country Report, Selected Issues and Statistical Appendix, 2000 to 2002; Standard & Poor's, Sovereigns Ratings Analysis; Asian
3	Moderate	Top income tax rate greater than 25% and less than or equal to 35%. Marginal rate for the average taxpayer greater than 10% and less than or equal to 15%.	
4	High	Top income tax rate greater than 35% and less than or equal to 50%. Marginal rate for the average taxpayer greater than 15% and less than or equal to 20%.	
5	Very high	Top income tax rate greater than 50%. Marginal rate for the average taxpayer greater than 20%.	
		Corporate tax grading scale	
1	Very low	Corporate tax rate less than or equal to 20%.	
2	Low	Corporate tax rate greater than 20% and less than or equal to 25%.	
3	Moderate	Corporate tax rate greater than 25% and less than or equal to 35%.	
4	High	Corporate tax rate greater than 35% and less than or equal to 45%.	
5	Very high	Corporate tax rate greater than 45%.	
		Government expenditures scale for developed countries	
1	Very low	Less than or equal to 15%.	
2	Low	Greater than 15% but less than or equal to 25%.	
3	Moderate	Greater than 25% but less than or equal to 35%.	
4	High	Greater than 35% but less than or equal to 45%.	
5	Very high	Greater than 45%.	

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Appendix A (*continued*)

Variable name in corresponding database (name in our database)	Scale		Description	Years	Sources
Fiscal burden					
Fiscal burden (ief_taxation)			*Government expenditures scale for developing countries*		Development Bank, Key Indicators of Developing Asian and Pacific Countries 2001; African Development Bank, ADB Statistics Pocketbook 2002; European Bank for Reconstruction and Development, Country Strategies; Inter– American Development Bank; U.S. Department of State, Country Commercial Guide 10; and official government publications of each country. Sources other than the OECD and the IMF are noted in the text.
	1	Very low	Less than or equal to 15%.		
	2	Low	Greater than 15% but less than or equal to 20%.		
	3	Moderate	Greater than 20% but less than or equal to 25%.		
	4	High	Greater than 25% but less than or equal to 30%.		
	5	Very high	Greater than 30%.		
Corporate tax % (kpmg_tax)	% rate		Corporate tax rate. The above rates do not reflect payroll taxes, social security taxes, net wealth taxes, turnover/sales taxes, and other taxes not levied on income. When two or more rates are reported, the highest number is chosen.	1997–2003 (annual)	Corporate Tax Rates Survey–KPMG, Switzerland, The survey (begun in 1993) currently covers 68 countries, including the 30-member countries of the Organization for Economic Cooperation and Development (OECD), and many countries in the Asia Pacific and Latin America regions. http://www.kpmg.com

1.D. Top marginal tax rate (efw_d)	0=heavy regulation	0 to 10	Average of 1.D.i. Top Marginal Income Tax Rate and 1.D.ii. Top Marginal Income and Payroll Tax Rate Countries with higher marginal tax rates that take effect at lower income thresholds received lower ratings. The income threshold data were converted from local currency to 1982/1984 U.S. dollars (using beginning-of-year exchange rates and the U.S. Consumer Price Index).	1970–2000 (5-year) and 2001	Economic Freedom of the World–The Fraser Institute, Based on: Price Waterhouse, Individual Taxes: A Worldwide Summary (various issues)
Labor regulation					
TUMMBR (ra_union)	%		Total trade union membership, in percent of the total labor force. Includes workers of both sexes in the public and the private sectors. In some countries, the union membership may include unemployed and retired workers who pay their dues. Based on the number of active contributors declared by the trade unions themselves and on labor force estimates. When declared membership is larger than the labor force, a 100% membership rate is reported.	1945–2000 (5 year)	A Database of Labor-Market Indicators Across Countries, M. Rama and R. Artecona, The World Bank, 2002.
Flexibility-of-hiring index (db_flex_hiring)	0 to 100, higher values indicating more rigid regulation		Covers the availability of part-time and fixed-term contracts	Survey conducted in 1997, updated to 2003	Doing Business–The World Bank–Hiring and Firing Workers see Botero Juan, Simeon Djankov, Rafael La Porta, Florencio Lopez-de-Silanes, and Andrei Shleifer, "The Regulation of Labor", Working Paper 9756, National Bureau of Economic Research, June 2003 Based on: NATLEX database (International Labor Organization); Constitutions, available online on the U.S. Law Library of Congress website; International

(continued on next page)

Appendix A (*continued*)

Variable name in corresponding database (name in our database)	Scale	Description	Years	Sources
Labor regulation				
Flexibility-of-hiring index (db_flex_hiring)				Encyclopaedia for Labor Law and Industrial Relations, and Social Security Programs Throughout the World. Legal advice from leading local law firms was solicited to confirm accuracy in all cases. Following the OECD Job Study and the International Encyclopaedia for Labour Law and Industrial Relations, the areas subject to statutory regulation in all countries were identified. Those include hiring of workers, conditions of employment, and firing of workers.
Conditions-of-employment index (db_cond_empl)	0 to 100, higher values indicating more rigid regulation	Covers working time requirements, including mandatory minimum daily rest, maximum number of hours in a normal workweek, premium for overtime work, restrictions on weekly holiday, mandatory payment for nonworking days, (which includes days of annual leave with pay and paid time off for holidays), and minimum wage legislation. The constitutional principles dealing with the minimum conditions of employment are also coded.	Survey conducted in 1997, updated to 2003	

Flexibility-of-firing index (db_flex_firing)	0 to 100, higher values indicating more rigid regulation	Covers workers' legal protections against dismissal, including grounds for dismissal, procedures for dismissal (individual and collective), notice period, and severance payment. The constitutional principles dealing with protection against dismissal are also coded.	Survey conducted in 1997, updated to 2003	
Bankruptcy				
Goals-of-insolvency index (db_close_insolv)	0 to 100	The measure documents the success in reaching the three goals of insolvency, as stated in Hart (1999). It is calculated as the simple average of the cost of insolvency (rescaled from 0 to 100, where higher scores indicate less cost), time of insolvency (rescaled from 0 to 100, where higher scores indicate less time), the observance of absolute priority of claims, and the efficient outcome achieved. A score 100 on the index means perfect efficiency.	2003	Doing Business–The World Bank–Closing a Business, see Djankov, Simeon, Oliver Hart, Tatiana Nenova, and Andrei Shleifer, "Efficiency in Bankruptcy", working paper, Department of Economics, Harvard University, July 2003.
Cost measure (db_close_cost)	%	Cost is defined as the cost of the entire bankruptcy process, including court costs, insolvency practitioners' costs, the cost of independent assessors, lawyers, accountants, etc. In all cases, the cost estimate excludes bribes. The cost figures are averages of the estimates in a multiple-choice question, where the respondents choose among the following options: 0–2%, 3–5%, 6–10%, 11–25%, 26–50%, and more than 50% of the insolvency estate value.	2003	
Court-powers index (db_close_court)	0 to 100	The measure documents the degree to which the court drives insolvency proceedings. It is an average of three indicators: whether the court appoints and replaces the insolvency administrator with no restrictions imposed by law, whether the reports of the administrator are accessible only to the court and not creditors, and whether the court decides on the adoption of the rehabilitation plan. The index is scaled from 0 to 100, where higher values indicate more court involvement in the insolvency process.	2003	

(continued on next page)

Appendix A (*continued*)

Variable name in corresponding database (name in our database)	Scale	Description	Years	Sources
Governance quality				
Corruption (icrg_corrup)	0 to 6	This is an assessment of corruption within the political system. The most common form of corruption met directly by business is financial corruption in the form of demands for special payments and bribes connected with import and export licenses, exchange controls, tax assessments, police protection, or loans. The measure takes such corruption into account, but it is more concerned with actual or potential corruption in the form of excessive patronage, nepotism, job reservations, 'favor-for-favors', secret party funding, and suspiciously close ties between politics and business.	1990–2000	International Country Risk Guide–PRS Group Index on Regulatory Burden Components Method
Law and order (icrg_laworder)	0 to 6	The Law subcomponent is an assessment of the strength and impartiality of the legal system, while the Order subcomponent is an assessment of popular observance of the law. Thus, a country can enjoy a high rating—3—in terms of its judicial system, but a low rating—1—if it suffers from a very high crime rate of if the law is routinely ignored without effective sanction.	1990–2000	

Democratic accountability (icrg_account)	0 to 6	Measure of the government's responsiveness to the people. The score depends on the type of regime: Alternating Democracy, Dominated Democracy, De facto One-party State, or De jure One-party State. Higher points are given to Alternating Democracies (see ICRG for details).	1990–2000

Index on Regulatory Burden

Components	Methods
ENTRY, TRADE, FINANCIAL MARKETS, CONTRACT, ENFORCEMENT, BANKRUPTCY, LABOR REGULATION, FISCAL BURDEN	We apply the following standardization formula to each component described above: $(X_i - X_{min})/ (X_{max} - X_{min})$ if higher values indicate heavier regulation, and $(X_{max} - X_i)/ (X_{max} - X_{min})$ if lower values indicate heavier regulation. Therefore, all values are distributed between 0 and 1, with higher values denoting heavier regulation. Next, we take the simple average of the components in each category to get the corresponding partial indicator. The overall index on regulatory burden is the simple average of the partial indicators.

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