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Abstract

Policies that curtail social and economic activities during a pandemic are predominantly decided upon at the national level, but have international ramifications. In this paper we examine what type of inefficiencies this may create and how cooperation across countries may improve outcomes. We find that inefficiencies arise even among completely identical countries. We show that countries are likely to choose excessively lenient policies from the perspective of world welfare in later stages of the pandemic. This provides a rationale for setting minimum containment standards internationally. By contrast, in early and intermediate stages of the pandemic, national containment policies may also be excessively strict. Whether or not this is the case depends on country's degree of economic integration relative to (outward and inward) mobility of people.

JEL Classification: F2, F5, F6, I1

Keywords: Covid-19 pandemic, cross-border cooperation, externalities

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National containment policies and international cooperation*

Thorsten Beck and Wolf Wagner†

Abstract

Policies that curtail social and economic activities during a pandemic are predominantly decided upon at the national level, but have international ramifications. In this paper we examine what type of inefficiencies this may create and how cooperation across countries may improve outcomes. We find that inefficiencies arise even among completely identical countries. We show that countries are likely to choose excessively lenient policies from the perspective of world welfare in later stages of the pandemic. This provides a rationale for setting minimum containment standards internationally. By contrast, in early and intermediate stages of the pandemic, national containment policies may also be excessively strict. Whether or not this is the case depends on country's degree of economic integration relative to (outward and inward) mobility of people. Analyzing the stringency of containment policies during the current epidemic confirms that countries with higher economic integration adopt stringent containment policies more quickly whereas countries subject to high mobility do so later.

Keywords: Covid-19 pandemic; cross-border cooperation; externalities

JEL codes: F2, F5, F6, I1

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1 Introduction

Governments around the world have responded with unprecedented measures to the spread of the COVID-19. Borders are now closed for travel among most major economies. Drastic policies have been introduced to curtail economic and social activity. The early evidence so far suggests that they have indeed helped to limit the spread of the virus, but at the same time there are likely to be significant economic consequences.

What is striking though is that even though the pandemic is clearly an international problem (as the spread of the virus from one country through nearly the entire world has shown), the policy responses are up to that moment entirely national. This suggests a potential tension. In an integrated world, uncoordinated national decisions of such severity are unlikely to produce a desirable outcome. Recently, policy makers have started to become aware of the issue. For example, the European Commission is starting to work on an exit-plan across the EU. However, little is known so far of what type of problems national containment policies create, if any. Even less is known about appropriate policy responses to such problems. How could a coordinated policy look like? Should it strive to increase the severity of containment or rather encourage countries to reverse them quickly? Should policies differ across countries, and the dynamics of the pandemic?

In this paper we analyze national containment policies in an integrated world. We examine two countries that independently choose their containment policies. We consider two stages of the pandemic, a *lockdown stage* with an initially severe spread of the virus and closed borders, and a *new normal* stage where the virus is fairly contained (but still alive and kicking!), and borders have been reopened. The two stages interact because containment policies in the first period affect the initial (pandemic) conditions in the second stage, and through this potentially optimal policies and welfare

In our model, countries independently choose their "activity-level" which can be given an economic or social interpretation. Activities provide net benefits to a country, but also facilitate the spread of the virus. Crucially, a country's activity choice has international repercussions, through economic channels and potentially also through spread of the virus across borders. We show that there are generally distortions in national decisions, but that

the direction and the intensity of the distortions depends on the stage of the pandemic as well as country characteristics. At an early stage, economic externalities from containment policies may dominate as countries incur significant losses due to disruptions in the supply chain. This implies that individual countries may choose containment policies that are excessive from the international perspective, as they do not internalize their negative consequences on the economies abroad. However, due to the dynamic impact of containment policies (arising because containing the virus domestically also affects the *new normal*, and through this also the other country), we show that countries may also choose excessively lenient policies, even in the early stage.

Over time, economic externalities decline as firms in other countries adjust to new conditions. In addition, the process of opening borders makes a second dimension of the externality more important, arising from international travel. This externality works in the opposite direction. A country that implements stricter containment measures benefits other countries because, by reducing the number of infecting people in its own country, there is less likely a spread of the virus to other countries.

Overall, we show that national containment policies are more likely to be excessive in initial stages of the pandemic, and for countries that are well internationally integrated. In later stages of the pandemic, by contrast, containment policies may be excessively lenient, and in particular so in countries that have a high mobility (inward and outward), such as popular tourist destinations. Based on these results we discuss various policy responses, such as minimum containment standards at the international level in later stages of the pandemic, as well stimulating higher stringency at individual countries through subsidies in earlier stages of the pandemic.

The central ingredients in our model follow closely the literature on the benefits and cost of international cooperation, which has emphasized cross-border externalities as a rationale for cooperation. For example, there is a clear potential benefit for macroeconomic policy coordination as both fiscal and monetary policy have effects beyond the country where they are instituted (see, for example, Cooper, 1969, and Hamada, 1976, for fiscal and monetary policy coordination, respectively). An example for such coordination is the Plaza accord of 1995. Cooperation efforts have more recently also been stepped up

following the Global Financial Crisis (for a review of the extant literature on macroeconomic policy coordination, see Frankel (2015)). The economic externality present in our paper is similar to the externalities arising from macroeconomic policies; the international "virus-externality", however, is not commonly considered in economics.[1]

Cooperation has also costs, arising from country heterogeneity. The literature on fiscal decentralization (see, for example, Oates, 1972) argues that the comparative advantage of centralization increases with the size of interjurisdictional externalities but decreases with preference heterogeneity.[2] A similar trade-off also applies to optimal currency areas and trade-blocs. Following Mundell (1961), a common currency can reduce spillovers from *beggar-thy-neighbour* policies. However, a cost of having a common currency is that countries are subject to different shocks (Mundell, 1961), hence their "optimal" exchange rate differs (Mundell, 1961, and Maloney and Macmillen, 1999). Dell'Arricia and Marquez (2006) consider cooperation in banking supervision. They show that the gains from delegating supervisory decisions to a supranational agency increase in cross-border externalities but decrease in heterogeneity across countries arising from preferences. Beck, Silva Buston and Wagner (2016) provide (indirect) evidence for such a trade-off by showing that countries are more likely to cooperate in the supervision of their banks when there are large bilateral externalities and when countries are similar to each other. In contrast to the majority of the literature, in this paper we mostly abstract from issues arising from country-heterogeneity.[3]

Within a very short time frame, the advent of the Corona-pandemic has spurred important contributions from policy makers and academics (see for example, the VoxEU-book on the "Economics in the Time of Covid-19", and the "Covid Economics" journal of CEPR). Perhaps most closely related to our paper is the analysis in Eichenbaum, Rebelo and Tra-

[1] Beyond economic cooperation, there is also a large tradition of successful cooperation in public health policies; for a discussion see Cooper (2001).

[2] Rogoff (1985) shows that cooperation also has a cost arising because it can reduce the credibility of national central banks.

[3] Generally, such heterogeneity works as an impediment to cooperation, so the cooperation gains identified in our analysis should be seen as an upper limit that may in practice not be reached due to political and other constraints.

bandt (2020), due to its complementary nature. Eichenbaum et al. model the macroeconomic implications of the pandemic and derive optimal policy responses from a domestic perspective. A key element in their paper is that economic activities create (negative) health externalities through interactions, by spreading the virus. Those externalities may arise in the production process, but also when products or services are consumed. The externalities provide a clear rationale for (domestic) policies to neutralize their negative effects, such as "taxing" economic activity (the shutdown of a sector can be seen as a prohibitive tax on this sector). Our analysis fully abstracts from this domestic dimension (we implicitly assume that domestic inefficiencies have been already solved through appropriate policies) but rather focus on the international aspect.

The following section sets up our model. Section 3 analyzes national containment policies. Section 4 contrasts with optimal international policies, and derives policy recommendations. Section 5 provides suggestive empirical evidence on cross-country variation on containment policies in Europe. The final section concludes.

2 Setup

We consider two identical countries, A and B (we will discuss asymmetry later) and examine two phases of the pandemic:

1. *Lockdown-phase*: There is a serious spread of the virus at the start of this period. Countries are implementing severe lockdown policies (curtailing both economic and social activities). All borders are closed.

2. *New-normal:* The virus is under control, but not fully eradicated. Countries have opened their borders again. National containment policies are still in place, but are now fairly light.

We thus do not model the initial spread of the virus, but directly enter a world where a significant number of people is infected. Arguably, our lockdown-phase could be further broken down into two parts: a strict lockdown-phase, and a period where countries are

starting to partially loosen their lockdown policies. As we will see later, the *direction* of the inefficiencies created in both stages are similar (their *intensity* is different though), so we analyze this as one stage. We also fully abstract from modelling explicitly the evolution of the virus spread (we do this in very simple reduced-form though), but focus here on the international ramifications of different stages of the pandemic (for a full analysis of the dynamics of a pandemic in a domestic context, see Eichenbaum, Rebelo and Trabandt 2020).

At each phase (date 1: lockdown; date 2: new normal) each country chooses its *activity*-level, x. The activity can be interpreted in an economic sense (how much to produce) or in a social sense (how much to engage in social interaction). Choosing an activity level of x brings about (net) benefits $b(x)$ (in absence of the virus). In the case of production, this can be interpreted as benefits from consuming good and services, or from exporting them. In the case of social interactions, its simply the utility derived from them. Note that these are already the *net* benefits. For example, for production this would amount to the profits (revenue minus costs). We assume that the relationship between the activity and the net benefits is concave ($b'(x) > 0, b''(x) < 0$). Let us denote with $\overline{x}$ the activity-level that maximizes net benefits (implicitly defined by $b'(\overline{x}) = 0$). We can interpret this as the country's pre-virus activity-level, i.e. the activity level that prevailed prior to the lockdown phase (an "imaginary" date 0).

When the virus is present in the economy, the action has the additional cost of spreading the virus (domestically). Specifically, let us denote the *severity* of the virus pandemic at the end of the prior period with s_{t-1} (≥ 0). We assume that the activity contributes to the spread of the virus, that is $s_t = f(x_t, s_{t-1})$ with $\frac{\partial f}{\partial x_t} > 0$ (and f bounded from above by the country's population number). In the case of production, the spread of the virus can either result in the production process itself (people working together to assemble a product), or when the good or service is consumed (as in Eichenbaum et al. 2020). We also assume that $\frac{\partial f}{\partial s_{t-1}} > 0$, that is, there is "memory" in the epidemic and higher severity in the previous period contributes to severity in the current period.[4] The prevalence of the

[4]Epidemiological models, however, suggest that this relationship could also be a negative one. In particular, by building up "herd immunity" early on, the consequences of the virus in later periods may

virus causes costs $v(s)$ ($v'(s) > 0$) to the country. This may be because of deaths, but also due to increased costs for the health care system

A country's choice of activity level also has externalities on the other country. These externalities depend crucially on whether borders are open and whether the activity level changes in an unexpected fashion. Consider first the lockdown-phase, during which borders are closed for travel. During this phase, externalities arise predominantly on the economic side. If a country reduces its (economic) activity level below $\overline{x}$, this will lead to an unexpected disruption in the production in other countries, through supply chain linkages. Shrinkage in production will also have negative consequence through aggregate demand spillovers in a recession, and because foreigners may hold claims on domestic firms. We capture these date-1 externalities by the function $e_1(x)$, with $e_1'(x) > 0$ when $x < \overline{x}$ (that is, higher domestic activity causes positive externalities abroad).

By contrast, externalities in the new-normal will be predominantly coming through spreading the virus. At this stage, borders are open, allowing people to travel internationally.[5] Direct disruptions in the production process from curtailing production in the other country are thought to be of less relevance then. This is because the production process will have adjusted; firms will have modified their supply chain and countries will have become more autarkic. We thus take the date-2 externalities to be decreasing in the activity level of the country: $e_2'(x) < 0$. For example, a less severe lockdown in a country (higher activity level) will mean that more people will become infected (in the country), and due to travel, this will lead to more infected people abroad.[6]

be mitigated. However, most countries in the world are not (or are no longer) following this strategy.

[5] We do not consider potential coordination problems that may arise from border openings. This is because border openings are *two-sided*; a country can always protect itself from a negative externality from another country opening its borders by keepings its own border closed.

[6] Formally, containment policies in our model refer to domestic activities. However, in a reality less strict containment policies will also enable (or encourage) international travel, further contributing to the spread of the virus.

3 National Policies

We now analyze how national policies will be chosen. Specifically, we consider governments that maximize the welfare of their citizen by optimally choosing activity-levels at date 1 and date 2. A higher activity level can be interpreted as a more lenient containment policy (for example, a government shuts down less sectors or relaxes lockdown restrictions).

A country's welfare consists of the combined (domestic) surplus from both periods, which for country A is given by

$$W^A(x_1^A, x_2^A, x_1^B, x_2^B) = b(x_1^A) - v(f(x_1^A, s_0^A)) + e_1(x_1^B) + b(x_2^A) - v(f(x_2^A, s_1^A)) + e_2(x_2^B). \quad (1)$$

The government maximizes domestic welfare choosing x_1^A and x_2^A, taking as given the foreign policy choices x_1^B and x_2^B.[7]

The FOCs for date 1 and date 2 are:

$$x_1^* \;:\; b'(x_1) = v'(s_1)\frac{\partial f(x_1, s_0)}{\partial x_1} + v'(s_2)\frac{\partial f(x_2, s_1)}{\partial s_1}\frac{\partial f(x_1, s_0)}{\partial x_1}, \quad (2)$$

$$x_2^* \;:\; b'(x_2) = v'(s_2)\frac{\partial f(x_2, s_1)}{\partial x_2}. \quad (3)$$

where we have suppressed the country-index due to symmetry.

Let us first consider the date-2 choice. At this date, the government trades-off higher benefits from the activity ($b'(x_2) > 0$) with resulting costs from a higher spread of the virus in this period ($v'(s_2)\frac{\partial f(x_2,s_1)}{\partial x_2} > 0$). The trade-off at date-1 is the same, except that there is now an additional *dynamic* cost from increasing the activity, captured by the term $v'(s_2)\frac{\partial f(x_2,s_1)}{\partial s_1}\frac{\partial f(x_1,s_0)}{\partial x_1} > 0$. It arises because a higher activity at date-1 leads to an increase in the virus spread at date-1, causing the economy to enter date 2 with a higher virus severity. For a given date-2 policy, the country would thus also end up with higher date-2 virus costs (the impact on the date-2 policy for welfare can be ignored, as per the envelope theorem).[8]

[7] In particular, we assume that a government also takes future foreign policy as given, that is, it does not perceive that when it changes its date-1 policy, the date-2 policy of the other country may be affected. The motivation is that in reality we have a large number of countries, and each country on its own is too small to perceive a meaningful influence of its own actions on the containment policies of other countries.

[8] This provides a reason for lower optimal activity levels (stricter lockdown) at date 1, compared to date

4 International Cooperation

How do the domestic policies differ from the ones that are efficient from the international perspective? The problem of optimal policies from the world perspective can be seen as choosing $(x_1^A, x_2^A, x_1^B, x_2^B)$ to maximize the combined welfare in the countries, $W^A + W^B$.

The FOC are given by

$$\begin{aligned} x_1^W \quad &: \quad b'(x_1) + e_1'(x_1) = v'(s_1)\frac{\partial f(x_1, s_0)}{\partial x_1} + v'(s_2)\frac{\partial f(x_2, s_1)}{\partial s_1}\frac{\partial f(x_1, s_0)}{\partial x_1} \qquad (4) \\ &\quad -e_2'(x_2)\frac{\partial f(x_2, s_1)}{\partial s_1}\frac{\partial f(x_1, s_0)}{\partial x_1}, \\ x_2^W \quad &: \quad b'(x_2) = v'(s_2)\frac{\partial f(x_2, s_1)}{\partial x_2} - e_2'(x_2). \qquad (5) \end{aligned}$$

These conditions differ from the domestic ones, given by (2) and (3). Starting again from date-2, we can see that the international solution perceives higher costs of activities than the domestic government (due to $e_2'(x_2) < 0$). Given the concavity of the problem, this means that a domestic government will choose a higher activity level than what is optimal from the world perspective: $x_2^* > x_2^W$. At date-1, there are two reasons why domestic and international solutions differ. First, a domestic government ignores that a higher level of date-1 activity leads to less economic disruptions in the other country at this date ($e_1'(x_1) > 0$). Second, it also ignores that a higher activity level will mean that there is a higher virus intensity in the next period, which will lower welfare abroad due to international travel ($e_2'(x_2) < 0$). It is thus not clear whether the domestic activity benefits exceed the international ones. In fact, they may also be lower than the international ones. Where or not this is the case depends on the ratio of the externalities, with corresponding consequences for the direction of the domestic activity bias.

We can summarize

Proposition 1 *Domestically chosen activity levels generally differ from the (globally) efficient ones:*

2. A second reason is that reducing the activity-level may be more effective (in absolute terms) when the prevailing virus severity is high (this is the case if $\frac{\partial^2 f(x_1,s)}{\partial x_1 \cdot \partial s} > 0$).

(i) In the lockdown-phase, domestic activity levels are excessive ($x_1^* > x_1^W$) *when* $|e_1'(x_1^*)| < |e_2'(x_1^*)| \frac{\partial f(x_2^*, s_1^*)}{\partial s_1} \frac{\partial f(x_1^*, s_0^*)}{\partial x_1}$ *and insufficient* ($x_2^* < x_2^W$) *when* $|e_1'(x_1^*)| > |e_2'(x_1^*)| \frac{\partial f(x_2^*, s_1^*)}{\partial s_1} \frac{\partial f(x_1^*, s_0^*)}{\partial x_1}$*;*

(ii) In the new-normal, domestic activity levels are excessive ($x_2^* > x_2^W$).

The proposition is derived for a symmetric setup that only allows common variation in externalities among countries (e.g., we can consider sets of countries with either both high or both low date-1 externalities). However, it is easy to see that the insights also carry over to assymmetric settings. In particular, when we have $\left|e_1^{A\prime}(x_1^*)\right|$ is sufficiently low (relative to $\left|e_2^{A\prime}(x_1^*)\right|$) for country A but sufficiently high for country B, date-1 activity levels will be excessive in A, but insufficient in B.

Proposition 1 suggests that in the new-normal, there is scope for policy coordination among countries, with the objective of avoiding that countries end up with too lax policies. This could take the form of minimum containment standards across countries. For example, countries may decide to discourage larger gatherings, such as sport events of festivals that exceed a threshold number of participants. Alternatively, this may take the form of countries making wearing masks for certain infection-prone activities (such as services like hairdressing) compulsory. Notably, give that the externalities in the new-normal phase (arising from travel) are essentially worldwide, one would need a global approach for this, for example orchestrated by the WHO. In the absence of global cooperation, regional cooperation, such as within the EU is called for. However, one may also expect to see individual approaches. For example, a country that sees a lot of its residents travelling to another country (tourism!) may put pressure on the other country to adhere to strict policies in order to avoid its citizen being infected while abroad (and bringing the virus back home).

In the lockdown-phase, policies can either be too lax or too lenient. We would expect them to be too strict for countries that display a high degree of economic integration, as in this case the date-1 externality, running among others through the supply chain, will be dominating. By contrast, for countries that have high "people integration" (that is, countries with a lot of mobility), the second externality may dominate and we may expect

such countries to be too lax in their policies (resulting in too high activity levels). We would thus anticipate excessive activity levels in fairly closed economies that have a high amount of travelling. Examples would be here typically tourist destinations, such as Thailand, Turkey or Greece. There is consequently international interest to curtail activities in such countries, in order to avoid a new spread of the virus.[9] By contrast, in countries with high economic integration relative to their international mobility, such as Germany or China (supply chain!), there may be international interest in relaxing their domestic restrictions, resulting in higher domestic activities that are less disruptive to global supply chains.

We may also expect the relative importance of the two externalities to vary during the lockdown-phase. In early stages of the lockdown phase, the economic externalities are expected to be severe, as the arrival of the lockdown comes as a full surprise. However, as the lockdown progresses, domestic economies will adjust. This suggests that as the lockdown phase progresses there will be a tendency for domestic activities levels to move from (possible) initial excessive strictness to (excess) leniency. This implies that the focus of international cooperation should change correspondingly during the lockdown policy.

5 Some suggestive empirical evidence

To provide suggestive evidence for our theoretical findings, we relate containment policies across 27 European countries to death rates and their reliance on merchandise trade and tourism. Specifically, we use data on the geographic distribution of COVID-related deaths from the European Centre for Disease Prevention and Control to identify the date when in each of the 27 countries the COVID-19 death toll has reached or passed 10 deaths.[10] We use data from a database put together by Olivier Lejeune[11] on containment policies across the globe to identify the date when non-essential shops, restaurants and bars closed as this is a measure that most European countries have taken now (some countries have gone even

[9] As the countries in question would see their economies contracting as a consequence, this may require subsidies from other countries. These subsidies could come from countries that loosen their excessively strict policies, and hence benefit economically.

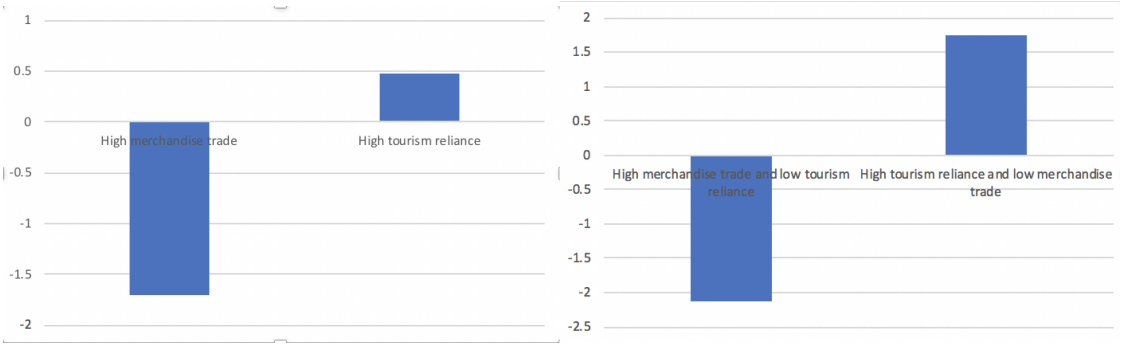
[10] We include EU countries except Latvia and Sweden, as well as the UK and Switzerland.

[11] https://github.com/OlivierLej/Coronavirus_CounterMeasures

further). We calculate the number of days between the date of 10 or more COVID-related deaths and this containment measure, which ranges between -20 (Bulgaria) to 12 (Italy), with lower numbers indicating a quicker adoption of containment policies. As countries were hit by the virus at different points in time, thus allowing for learning effects, we first regress this difference on the date of 10 or more COVID-related deaths and find a significant and negative relationship, i.e., countries that experienced the outbreak later imposed containment policies more quickly.[12] We then compare the residuals from this crisis across four groups of countries, countries with above and below median merchandise trade to GDP and countries with above and below international tourism receipts as share of exports (data from the World Development Indicators and for 2018).

Figure 1 provides suggestive evidence consistent with our model. Countries with above median merchandise exports were quicker in imposing containment policies, not taking into account externalities on other countries through supply chains or demand externalities. Countries with above median reliance on tourism, on the other hand, were slower in imposing containment policies. When considering the two groups of countries in the two extremes of our two variables high (low) merchandise trade and low (high) reliance on tourism the difference is even stronger.

Figure 1: Variation in containment policies



[12] For countries that have not reached ten deaths yet, we set the date at 100 days after Italy and the difference between this date and the adoption of containment policy at -50. Two countries - Latvia and Sweden, which had not adopted robust containment policies as of 6 April - are dropped from the analysis.

6 Conclusions

This paper has analyzed the question of whether national containment policies lead to international inefficiencies. The answer is yes, even in a fully symmetric world. The direction of the efficiency is shown to depend both on the stage of the epidemic, as well as country characteristics, such as economic integration and mobility. Based on this we have derived policy recommendations for countries can eliminate (or at least reduce) the inefficiencies. Importantly, given the global nature of the virus pandemic (both in terms of the pandemic itself, but also in terms of spillovers from containment policies), measures that aim to be effective have to be taken at the truly global level (for example, instigated by the WHO).

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