NEREUS

Núcleo de Economia Regional e Urbana da Universidade de São Paulo

The University of São Paulo Regional and Urban Economics Lab

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WORKSHOP

Assessing the Economic Impacts of the COVID-19 Pandemic on Sectoral and Regional Growth: The Case of Morocco

24 March 2021

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Pandemia, Economia e Sociedade

Contribuições do NEREUS para o enfrentamento da crise da COVID-19

http://www.usp.br/nereus/?p=7869

https://www.policycenter.ma/publications/impact-covid-19-morocco-macroeconomic-sectoral-and-regional-effects

Objective

What are the daily economic costs of the control measures adopted in the country to prevent the spread of Covid-19?

How do flexibility measures affect the economy?

The objective of the study is to calculate the regional and sectoral economic impacts of preventive measures related to the coronavirus pandemic in Morocco, as well as the impacts of the gradual reopening of the economy

Methodology (São Paulo, Colombia, Brazil, Morocco, Angola…)

Technical Report | Full-text available

Input-Output Analysis of COVID-19: Methodology for Assessing the Impacts of Lockdown Measures

April 2020

DOI: 10.13140/RG.2.2.10381.69602

Report number: TD NEREUS 01-2020 · Affiliation: University of São Paulo

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https://www.researchgate.net/publication/340491646_Input-Output_Analysis_of_COVID-19_Methodology_for_Assessing_the_Impacts_of_Lockdown_Measures

https://ideas.repec.org/p/ris/nereus/2020_001.html

Methodology

https://www.tandfonline.com/doi/full/10.1080/17421772.2020.1844284

Methodology

Regional Science Policy&Practice
Regional Science Association International

ORIGINAL ARTICLE | Free Access

Regional economic impact of COVID-19 in Colombia: An input–output approach

Jaime Bonet-Morón, Diana Ricciulli-Marín, Gerson Javier Pérez-Valbuena, Luis Armando Galvis-Aponte, Eduardo A. Haddad, Inácio F. Araújo, Fernando S. Perobelli

First published: 29 July 2020 | https://doi.org/10.1111/rsp3.12320 | Citations: 2

https://rsaiconnect.onlinelibrary.wiley.com/doi/full/10.1111/rsp3.12320

Scientific interest

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1	List, John	721	2,377	7,896	60,669	3,891	11,909	41,517	215,971
2	Wooldridge, Jeffrey Marc	670	2,327	7,333	103,860	2,141	7,080	23,297	270,026
3	Stiglitz, Joseph E.	484	1,616	6,252	181,687	2,200	7,645	25,625	536,596
4	Barro, Robert J.	470	1,409	5,860	182,964	2,113	6,750	24,563	537,096
5	Acemoglu, Daron	391	1,374	5,719	139,272	3,104	9,487	34,830	498,130
6	Bonet, Jaime Alfredo	188	1,059	4,561	12,000	516	2,822	10,900	56,749
7	Galvis-Aponte, Luis Armando	254	1,135	4,473	13,997	633	3,223	11,578	47,030
8	Heckman, James J.	299	1,003	4,452	184,410	2,179	6,802	22,409	548,040
9	Haddad, Eduardo Amaral	264	1,357	4,370	13,946	718	3,284	9,412	38,499
10	Pesaran, M Hashem	338	1,131	4,299	129,149	1,871	6,057	20,230	430,074
11	Levine, Ross	329	1,049	4,287	173,655	2,636	7,299	25,641	502,286
12	Asongu, Simplice A	228	924	4,197	31,713	2,393	6,818	26,138	104,729
13	Krugman, Paul R.	338	1,175	4,060	138,102	1,598	4,628	16,065	390,098
14	Demirguc-Kunt, Asli	311	982	4,039	117,121	2,621	7,045	24,956	358,649
15	Sengupta, Rajeswari	322	975	4,025	6,539	3,152	8,851	31,162	38,342
16	Nordhaus, William D.	295	1,071	4,010	52,957	1,131	3,746	13,867	185,775
17	Pérez Valbuena, Gerson Javier	164	945	3,899	8,914	411	2,570	9,287	34,113
18	Jenkins, Glenn Paul	270	1,051	3,707	48,224	1,626	5,903	21,211	211,762
19	Becker, Gary S.	336	1,071	3,685	107,913	1,783	5,089	17,601	400,254
20	Shleifer, Andrei	285	985	3,656	196,559	2,345	6,791	25,240	666,267
21	Bernanke, Ben S.	260	848	3,542	128,305	1,470	3,947	14,714	359,184
22	Eichengreen, Barry Julian	276	823	3,474	113,967	1,703	4,711	19,335	434,384
23	Fama, Eugene F.	315	930	3,429	97,673	1,149	3,310	12,259	262,787
24	Thaler, Richard H.	264	828	3,410	75,093	1,115	3,213	12,209	221,162
25	Perobelli, Fernando Salgueiro	160	868	3,398	6,927	429	2,120	6,547	21,503

Statistics updated 2021-01-03

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Rank	Working Paper	File Downloads				Abstract Views		
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1	Covid-19: Impact on the Indian economy *S. Mahendra Dev* and *Rajeswari Sengupta*	276	841	3,637	3,637	2,875	8,035	29,053
2	The Economic Effects of the 1918 Influenza Epidemic *Elizabeth Brainerd* and *Mark Siegler*	50	159	2,611	3,512	236	800	14,128
3	Impacto económico regional del Covid-19 en Colombia: un análisis insumo-producto *Jaime Bonet*, *Diana Ricciulli-Marin*, *Gerson Javier Pérez-Valbuena*, *Luis Galvis-Aponte*, *Eduardo Haddad*, *Inácio Araújo* and *Fernando Perobelli* (*Gerson Javier Pérez Valbuena*)	72	442	1,952	1,952	102	769	2,712
4	The role of education in economic development: a theoretical perspective *Ilhan Ozturk*	163	499	1,679	24,663	2,288	6,856	23,720
5	Policies and strategies to promote social equity in health. Background document to WHO - Strategy paper for Europe *Göran Dahlgren* and *Margaret Whitehead*	150	432	1,452	6,878	505	1,417	4,439

Basic database

Technical Appendix

We consider an interregional input-output flow-table for an n-sector economy with r regions (Figure A1). We separate workers into q different age groups, and identify payments by producers to wage earners in each of these groups.

Figure A1. Interregional Input-Output Flows

		Processing sectors							*Final demand*				*Total output*
		11	⋯	rn	⋯	$r1$	⋯	rn					
Processing sectors	11	$\mathbf{Z}_{11}^{11}$	⋯	$\mathbf{Z}_{1n}^{11}$		$\mathbf{Z}_{11}^{1r}$	⋯	$\mathbf{Z}_{1n}^{1r}$	$\mathbf{c}_1^{1\bullet}$	$\mathbf{i}_1^{1\bullet}$	$\mathbf{g}_1^{1\bullet}$	$\mathbf{e}_1^{1\bullet}$	x_1^1
	⋮	⋮	⋱	⋮	⋯	⋮	⋱	⋮	⋮	⋮	⋮	⋮	⋮
	$1n$	$\mathbf{Z}_{n1}^{11}$	⋯	$\mathbf{Z}_{nn}^{11}$		$\mathbf{Z}_{n1}^{1r}$	⋯	$\mathbf{Z}_{nn}^{1r}$	$\mathbf{c}_n^{1\bullet}$	$\mathbf{i}_n^{1\bullet}$	$\mathbf{g}_n^{1\bullet}$	$\mathbf{e}_n^{1\bullet}$	x_n^1
	⋮		⋮		⋱		⋮		⋮	⋮	⋮	⋮	⋮
	$r1$	$\mathbf{Z}_{11}^{r1}$	⋯	$\mathbf{Z}_{1n}^{r1}$		$\mathbf{Z}_{11}^{rr}$	⋯	$\mathbf{Z}_{1n}^{rr}$	$\mathbf{c}_1^{r\bullet}$	$\mathbf{i}_1^{r\bullet}$	$\mathbf{g}_1^{r\bullet}$	$\mathbf{e}_1^{r\bullet}$	x_1^r
	⋮	⋮	⋱	⋮	⋯	⋮	⋱	⋮	⋮	⋮	⋮	⋮	⋮
	rn	$\mathbf{Z}_{n1}^{r1}$	⋯	$\mathbf{Z}_{nn}^{r1}$		$\mathbf{Z}_{n1}^{rr}$	⋯	$\mathbf{Z}_{nn}^{rr}$	$\mathbf{c}_n^{r\bullet}$	$\mathbf{i}_n^{r\bullet}$	$\mathbf{g}_n^{r\bullet}$	$\mathbf{e}_n^{r\bullet}$	x_n^r
Imports		m_1^1	⋯	m_n^1	⋯	m_1^r	⋯	m_n^r	$m_c^\bullet$	$m_i^\bullet$	$m_g^\bullet$	$m_e^\bullet$	m
Indirect taxes		t_1^1	⋯	t_n^1	⋯	t_1^r	⋯	t_n^r	$t_c^\bullet$	$t_i^\bullet$	$t_g^\bullet$	$t_e^\bullet$	t
Labor payments	l	l_{11}^1	⋯	l_{1n}^1	⋯	l_{11}^r	⋯	l_{1n}^r					l_1
	⋮		⋮		⋯		⋮						⋮
	q	l_{q1}^1	⋯	l_{qn}^1	⋯	l_{q1}^r	⋯	l_{qn}^r					l_q
Other payments		n_1^1	⋯	n_n^1	⋯	n_1^r	⋯	n_n^r					n
Outlays		x_1^1	⋯	x_n^1	⋯	x_1^r	⋯	x_n^r	c	i	g	e	
Employment	l	L_{11}^1	⋯	L_{1n}^1	⋯	L_{11}^r	⋯	L_{1n}^r					L_1
	⋮		⋮		⋯		⋮						⋮
	q	L_{q1}^1	⋯	L_{qn}^1	⋯	L_{q1}^r	⋯	L_{qn}^r					L_q

The F factors: what are they?

We assume that a given lockdown strategy may initially restrict part of the labor force in performing their tasks. In the context of the COVID-19 pandemic, lockdown strategies are usually both age, sector and region-specific. Thus, we define $qxnxs$ factors $(F^{s}_{q,n})$ where $0 < F^{s}_{q,n} < 1$, defining the share of non-restricted workers in each group in each sector in each region. This allows the model to be responsive to sector-labor specific characteristics. For instance, in a non-restrictive scenario for health-sector workers, we set the factor to 1; for activities that would face stronger restrictions, such as those in the entertainment sector, we set the factor closer to zero[11].

The F factors: from employment and labor income to output loss

We then apply each factor $F^{s}_{q,n}$ to its corresponding element in both the employment matrix and the labor payments matrix. In the former case, we are able to define the number of workers facing lockdown; in the latter case, we can calculate the contribution of those workers to total labor income in each sector in each region. Once we know the aggregate income associated with restricted (and non-restricted) workers, we use its share in total labor payments by sector and region together with the sectoral labor payment coefficients, $\sum_{i}^{q} l^{s}_{ij}/x^{s}_{j}$. Based on the properties of the Leontief production function, we can then define a new set of sector-specific penalty factors (F^{s}_{n}), where $0 < F^{s}_{n} < 1$, identifying the share of output in each sector associated with non-restricted workers in each region.

The F factors: adjusting policies scenarios to the level of compliance

This approach also allows us to assess different scenarios based on targets for compliance with the measures. Suppose we want to examine a scenario that is both consistent with the set of pre-defined factors ($F^{s}_{q,n}$) and a desirable level of compliance (α). We can then find an adjustment factor or weight (ω) to be applied across all $F^{s}_{q,n}$ so that[12]

$$\omega F^{s}_{q,n} \Longrightarrow \sum_{i}^{q}\sum_{j}^{n} L_{ij}^{s,restricted} / \sum_{i}^{q}\sum_{j}^{n} L_{ij}^{s} = \alpha \qquad (1)$$

Once we have computed the factors, F^{s}_{n}, the next step is to use this set of information to partially extract some of the sectoral flows in the interregional input-output table, considering both demand and supply reductions.

The F factors: how do we use them? (1)

Interindustry Demand:

$\forall\ z_{ij}^{rs}$, $i, j=1, \ldots, n$ and $r, s=1, \ldots, r$ we compute a corresponding restricted flow, $\overline{z_{ij}^{rs}}$, such that

$$\overline{\overline{z_{ij}^{rs}}} = \begin{cases} F_i^r z_{ij}^{rs}, \text{if } F_i^r < F_j^s \\ F_j^s z_{ij}^{rs}, \text{if } F_i^r > F_j^s \end{cases} \qquad (2)$$

Technical Appendix

We consider an interregional input-output flow-table for an n-sector economy with r regions (Figure A1). We separate workers into q different age groups, and identify payments by producers to wage earners in each of these groups.

Figure A1. Interregional Input-Output Flows

		Processing sectors							*Final demand*				*Total output*
		11	$\cdots$	rn	$\cdots$	$r1$	$\cdots$	rn					
Processing sectors	11	$\mathbf{Z}_{11}^{11}$	$\cdots$	$\mathbf{Z}_{1n}^{11}$		$\mathbf{Z}_{11}^{1r}$	$\cdots$	$\mathbf{Z}_{1n}^{1r}$	$\mathbf{c}_1^{1\bullet}$	$\mathbf{i}_1^{1\bullet}$	$\mathbf{g}_1^{1\bullet}$	$\mathbf{e}_1^{1\bullet}$	x_1^1
	$\vdots$	$\vdots$	$\ddots$	$\vdots$	$\cdots$	$\vdots$	$\ddots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
	$1n$	$\mathbf{Z}_{n1}^{11}$	$\cdots$	$\mathbf{Z}_{nn}^{11}$		$\mathbf{Z}_{n1}^{1r}$	$\cdots$	$\mathbf{Z}_{nn}^{1r}$	$\mathbf{c}_n^{1\bullet}$	$\mathbf{i}_n^{1\bullet}$	$\mathbf{g}_n^{1\bullet}$	$\mathbf{e}_n^{1\bullet}$	x_n^1
	$\vdots$		$\vdots$		$\ddots$		$\vdots$		$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
	$r1$	$\mathbf{Z}_{11}^{r1}$	$\cdots$	$\mathbf{Z}_{1n}^{r1}$		$\mathbf{Z}_{11}^{rr}$	$\cdots$	$\mathbf{Z}_{1n}^{rr}$	$\mathbf{c}_1^{r\bullet}$	$\mathbf{i}_1^{r\bullet}$	$\mathbf{g}_1^{r\bullet}$	$\mathbf{e}_1^{r\bullet}$	x_1^r
	$\vdots$	$\vdots$	$\ddots$	$\vdots$	$\cdots$	$\vdots$	$\ddots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
	rn	$\mathbf{Z}_{n1}^{r1}$	$\cdots$	$\mathbf{Z}_{nn}^{r1}$		$\mathbf{Z}_{n1}^{rr}$	$\cdots$	$\mathbf{Z}_{nn}^{rr}$	$\mathbf{c}_n^{r\bullet}$	$\mathbf{i}_n^{r\bullet}$	$\mathbf{g}_n^{r\bullet}$	$\mathbf{e}_n^{r\bullet}$	x_n^r
Imports		m_1^1	$\cdots$	m_n^1	$\cdots$	m_1^r	$\cdots$	m_n^r	$m_c^\bullet$	$m_i^\bullet$	$m_g^\bullet$	$m_e^\bullet$	m
Indirect taxes		t_1^1	$\cdots$	t_n^1	$\cdots$	t_1^r	$\cdots$	t_n^r	$t_c^\bullet$	$t_i^\bullet$	$t_g^\bullet$	$t_e^\bullet$	t
Labor payments	1	l_{11}^1	$\cdots$	l_{1n}^1	$\cdots$	l_{11}^r	$\cdots$	l_{1n}^r					l_1
	$\vdots$		$\vdots$		$\cdots$		$\vdots$						$\vdots$
	q	l_{q1}^1	$\cdots$	l_{qn}^1	$\cdots$	l_{q1}^r	$\cdots$	l_{qn}^r					l_q
Other payments		n_1^1	$\cdots$	n_n^1	$\cdots$	n_1^r	$\cdots$	n_n^r					n
Outlays		x_1^1	$\cdots$	x_n^1	$\cdots$	x_1^r	$\cdots$	x_n^r	c	i	g	e	
Employment	1	L_{11}^1	$\cdots$	L_{1n}^1	$\cdots$	L_{11}^r	$\cdots$	L_{1n}^r					L_1
	$\vdots$		$\vdots$		$\cdots$		$\vdots$						$\vdots$
	q	L_{q1}^1	$\cdots$	L_{qn}^1	$\cdots$	L_{q1}^r	$\cdots$	L_{qn}^r					L_q

The F factors: how do we use them? (2)

Final Demand:

In addition to supply-side restrictions, associated with the factor (F_i^r), additional demand-side constraints can be added to complete the decision rule.

For each final demand user, a demand-side factor, F_u^s , $u=c, i, g, e$, and $s=1, \ldots, r$ can be specified. We define each F_u^s as follows.

F_c^s is calculated based on changes in foregone earnings by workers in region s affected by the control strategies for mitigating the effects of COVID-19. While informal workers affected by the lockdown face a full loss of income, those in the formal sector may face only a partial loss, according to a parameter (δ^s), where $0< \delta^s<1$ for $s=1, \ldots, r$. We then assume labor income changes are fully translated into household demand changes. Other possible income-related changes, such as government transfers to specific groups of workers as a measure to attenuate the effects of the crisis, would also affect F_c^s after properly mapped into household purchases.

F_i^s and F_g^s are set to unity. The implicit assumption is that investments decisions that are taking place are not affected in the very short-run, while government expenditures are kept unchanged, from the demand perspective, so that we can use government reactions for simulating policy scenarios and providing alternative values for F_g^s .

$F_e^{\bullet}$ is set to 0.75, based on the OECD projections of short-term declines in GDP for many major economies. Accordingly, in the median economy, output would decline by 25%[13].

Basic database

Technical Appendix

We consider an interregional input-output flow-table for an n-sector economy with r regions (Figure A1). We separate workers into q different age groups, and identify payments by producers to wage earners in each of these groups.

Figure A1. Interregional Input-Output Flows

		Processing sectors							*Final demand*				*Total output*
		11	⋯	rn	⋯	$r1$	⋯	rn					
Processing sectors	11	$\mathbf{Z}_{11}^{11}$	⋯	$\mathbf{Z}_{1n}^{11}$		$\mathbf{Z}_{11}^{1r}$	⋯	$\mathbf{Z}_{1n}^{1r}$	$\mathbf{c}_1^{1\bullet}$	$\mathbf{i}_1^{1\bullet}$	$\mathbf{g}_1^{1\bullet}$	$\mathbf{e}_1^{1\bullet}$	x_1^1
	⋮	⋮	⋱	⋮	⋯	⋮	⋱	⋮	⋮	⋮	⋮	⋮	⋮
	$1n$	$\mathbf{Z}_{n1}^{11}$	⋯	$\mathbf{Z}_{nn}^{11}$		$\mathbf{Z}_{n1}^{1r}$	⋯	$\mathbf{Z}_{nn}^{1r}$	$\mathbf{c}_n^{1\bullet}$	$\mathbf{i}_n^{1\bullet}$	$\mathbf{g}_n^{1\bullet}$	$\mathbf{e}_n^{1\bullet}$	x_n^1
	⋮		⋮		⋱		⋮		⋮	⋮	⋮	⋮	⋮
	$r1$	$\mathbf{Z}_{11}^{r1}$	⋯	$\mathbf{Z}_{1n}^{r1}$		$\mathbf{Z}_{11}^{rr}$	⋯	$\mathbf{Z}_{1n}^{rr}$	$\mathbf{c}_1^{r\bullet}$	$\mathbf{i}_1^{r\bullet}$	$\mathbf{g}_1^{r\bullet}$	$\mathbf{e}_1^{r\bullet}$	x_1^r
	⋮	⋮	⋱	⋮	⋯	⋮	⋱	⋮	⋮	⋮	⋮	⋮	⋮
	rn	$\mathbf{Z}_{n1}^{r1}$	⋯	$\mathbf{Z}_{nn}^{r1}$		$\mathbf{Z}_{n1}^{rr}$	⋯	$\mathbf{Z}_{nn}^{rr}$	$\mathbf{c}_n^{r\bullet}$	$\mathbf{i}_n^{r\bullet}$	$\mathbf{g}_n^{r\bullet}$	$\mathbf{e}_n^{r\bullet}$	x_n^r
Imports		m_1^1	⋯	m_n^1	⋯	m_1^r	⋯	m_n^r	$m_c^\bullet$	$m_i^\bullet$	$m_g^\bullet$	$m_e^\bullet$	m
Indirect taxes		t_1^1	⋯	t_n^1	⋯	t_1^r	⋯	t_n^r	$t_c^\bullet$	$t_i^\bullet$	$t_g^\bullet$	$t_e^\bullet$	t
Labor payments	1	l_{11}^1	⋯	l_{1n}^1	⋯	l_{11}^r	⋯	l_{1n}^r					l_1
	⋮		⋮		⋯		⋮						⋮
	q	l_{q1}^1	⋯	l_{qn}^1	⋯	l_{q1}^r	⋯	l_{qn}^r					l_q
Other payments		n_1^1	⋯	n_n^1	⋯	n_1^r	⋯	n_n^r					n
Outlays		x_1^1	⋯	x_n^1	⋯	x_1^r	⋯	x_n^r	c	i	g	e	
Employment	1	L_{11}^1	⋯	L_{1n}^1	⋯	L_{11}^r	⋯	L_{1n}^r					L_1
	⋮		⋮		⋯		⋮						⋮
	q	L_{q1}^1	⋯	L_{qn}^1	⋯	L_{q1}^r	⋯	L_{qn}^r					L_q

The F factors: how do we use them? (2)

Thus, considering each component of final demand, f_{iu}^{rs}, we apply the following rule:

$\forall\ f_{iu}^{rs}$, $i=1, \ldots, n, u=i, g, e$ and $r, s=1, \ldots, r$ we compute a corresponding restricted flow, $\overline{f_{iu}^{rs}}$, such that

$$\overline{f_{iu}^{rs}} = \begin{cases} F_i^r f_{iu}^{rs}, \text{if } F_i^r < F_u^s \\ F_u^s f_{iu}^{rs}, \text{if } F_i^r > F_u^s \end{cases} \qquad (3)$$

The F factors: how do we use them? (2)

In the case of household demand, we apply both the supply and the demand constraints, such that

$\forall\ f_{iu}^{rs}$, $i=1, \ldots, n, u=c$ and $r, s=1, \ldots, r$ we compute a corresponding restricted flow, $\overline{f_{iu}^{rs}}$, such that

$$\overline{f_{iu}^{rs}} = F_i^r F_u^s f_{iu}^{rs} \qquad (4)$$

Using the information from the original and the diminished sectoral flows, we have now two matrices of interindustry flows, $\mathbf{Z}$ and $\overline{\mathbf{Z}}$, and two vectors of final demand, $\mathbf{f}$ and $\overline{\mathbf{f}}$. For a given vector of sectoral output, $\mathbf{x}$, we can also derive two matrices of technical coefficients, $\mathbf{A}$ and $\overline{\mathbf{A}}$.

The Extraction Method

The extraction method, initially proposed by Dietzenbacher et al. (1993), consists of the hypothetical extraction of a sector/region in the input-output matrix

The purpose is to quantify how much the total output of an economy with *n* sectors could change (or reduce) if a particular sector/region were removed from this economy

This technique allows to analyzing the importance of a sector/region in an economic structure given its extraction and consequent reduction in the level of activity in the economy

It should be emphasized that the greater the level of interdependence of this sector/region in relation to the others, the greater the impact, in a **systemic way**

Example: sectoral extraction

Initially, the extraction is modeled by an input-product matrix deleting the *j-th* row and column of matrix ***A***

Using $\bar{\boldsymbol{A}}_{(j)}$ for the matrix of dimensions *(n - 1) x (n - 1)* without the sector *j* and $\bar{\boldsymbol{f}}_{(j)}$ for the reduced final demand vector (*i.e.* without sector *j*), production in the reduced economy (*i.e.* without sector *j*) will be given by:

$$\bar{\boldsymbol{x}}_{(j)} = \left(\boldsymbol{I} - \bar{\boldsymbol{A}}_{(j)}\right)^{-1} \bar{\boldsymbol{f}}_{(j)} \qquad (1)$$

Instead of physically deleting the *j-th* row and column in matrix ***A*** and the *j-th* element of vector ***f***, one can simply replace these values with zeros

Example: sectoral extraction

In the complete model, with *n* sectors, the output of the economy is given by:

$$\boldsymbol{x} = (\boldsymbol{I} - \boldsymbol{A})^{-1}\boldsymbol{f} \qquad (2)$$

Therefore, after extraction:

$$\boldsymbol{T}_j = \boldsymbol{i}'\boldsymbol{x} - \boldsymbol{i}'\overline{\boldsymbol{x}}_{(j)} \qquad (3)$$

where $\boldsymbol{T}_j$ is the aggregate measure of loss in the economy – decrease in total output if the sector *j* "disappears". In other words, it is a measure of the relative importance of sector *j*, or the total linkages of sector *j*.

From annual output to daily value added losses

We can translate sectoral gross output outcomes in other variable outcomes. To do so we multiply the vector of gross output, $\mathbf{x}$ or $\overline{\mathbf{x}}$, by a diagonal matrix, $\hat{\mathbf{v}}$, whose main diagonal contains the variable's coefficients, i.e. the ratios of the variable values by sector-region divided by the respective sectoral-regional gross output. Finally, assuming that production is continuous on weekdays, daily foregone losses can be estimated by dividing $\mathbf{T}$ (or $\hat{\mathbf{v}}\mathbf{T}$), by the number of weekdays in the benchmark year.

Interregional input-output model for Morocco

Sectoral and regional interdependence in Morocco

Production function continuous in time

Workers in each sector classified by age group

Segmentation of the labor market (formal and informal)

Effects of isolation on supply and demand (partial "hypothetical extraction")

Effects on consumption proportional to the direct loss of income in each region

Additional effects on exports on the demand side

Losses in terms of GDP generation

Methodology (simulator)

Calculate the output of the economy in a hypothetical scenario of isolation through the partial extraction of the sectorial flows in the input-output matrix

Define, for each sector, an adjustment factor **F**, which measures the degree of exposure of the sector considering those sectors that must continue in operation (**F**=1) up to those that may stop operating (**F**=0)

Extract from the labor force a hypothetical percentage in similar proportions of formal and informal workers in each sector and in each region

Define, for each group of workers, the fraction of income maintained during the isolation period

Estimate economic loss by comparing the base scenario with the hypothetical scenario

Methodology (summary)

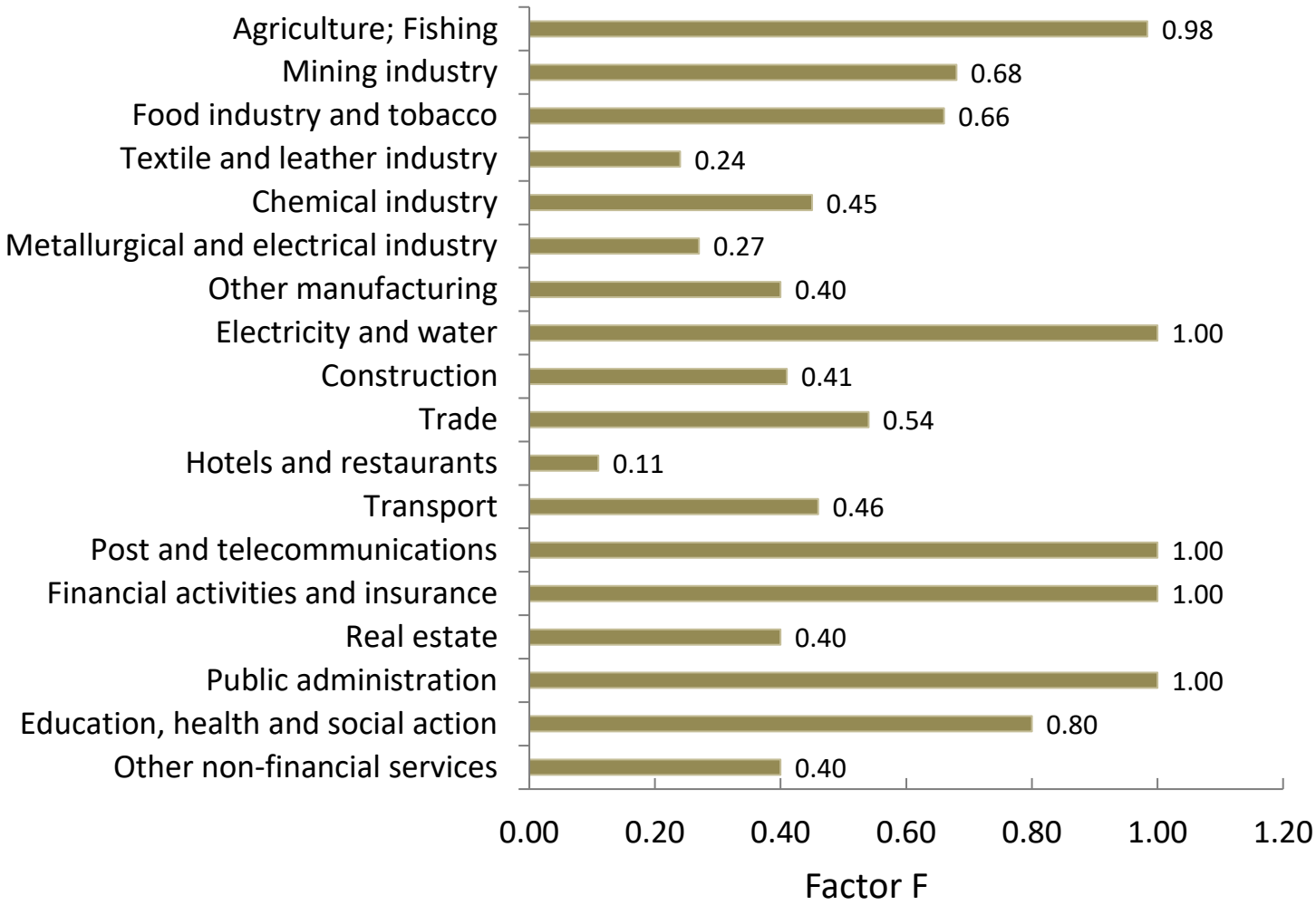
Channels:

- Supply shocks and domestic value chain effects
- Income effects on consumption
- External demand

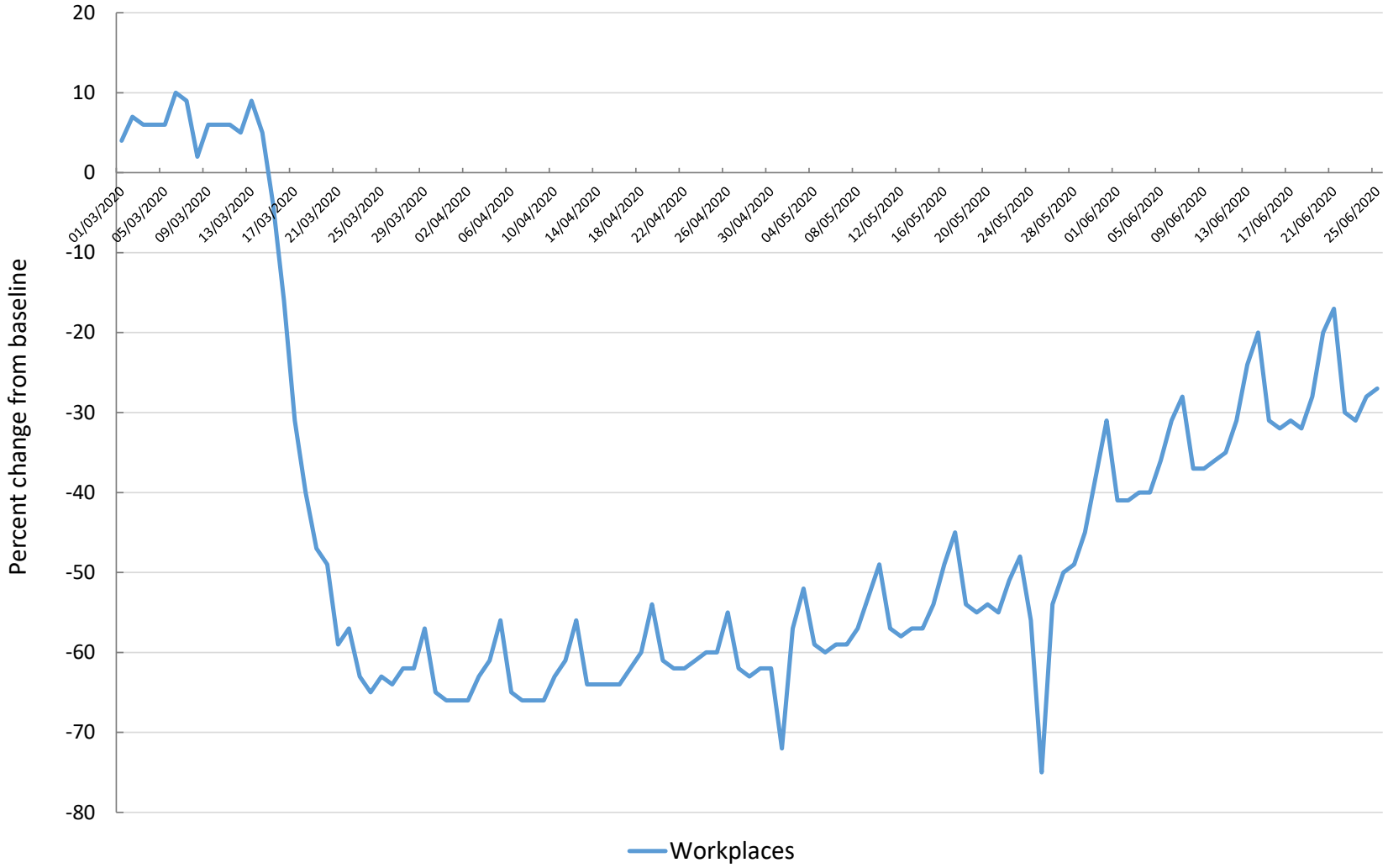
Mitigation measures by the government: the creation of the fund, lump sum transfers and other economic buffers

Adjusting for the containment compliance and the relaxing measures along the 14-week lockdown: Google Mobility data

Factor F (Week 2)

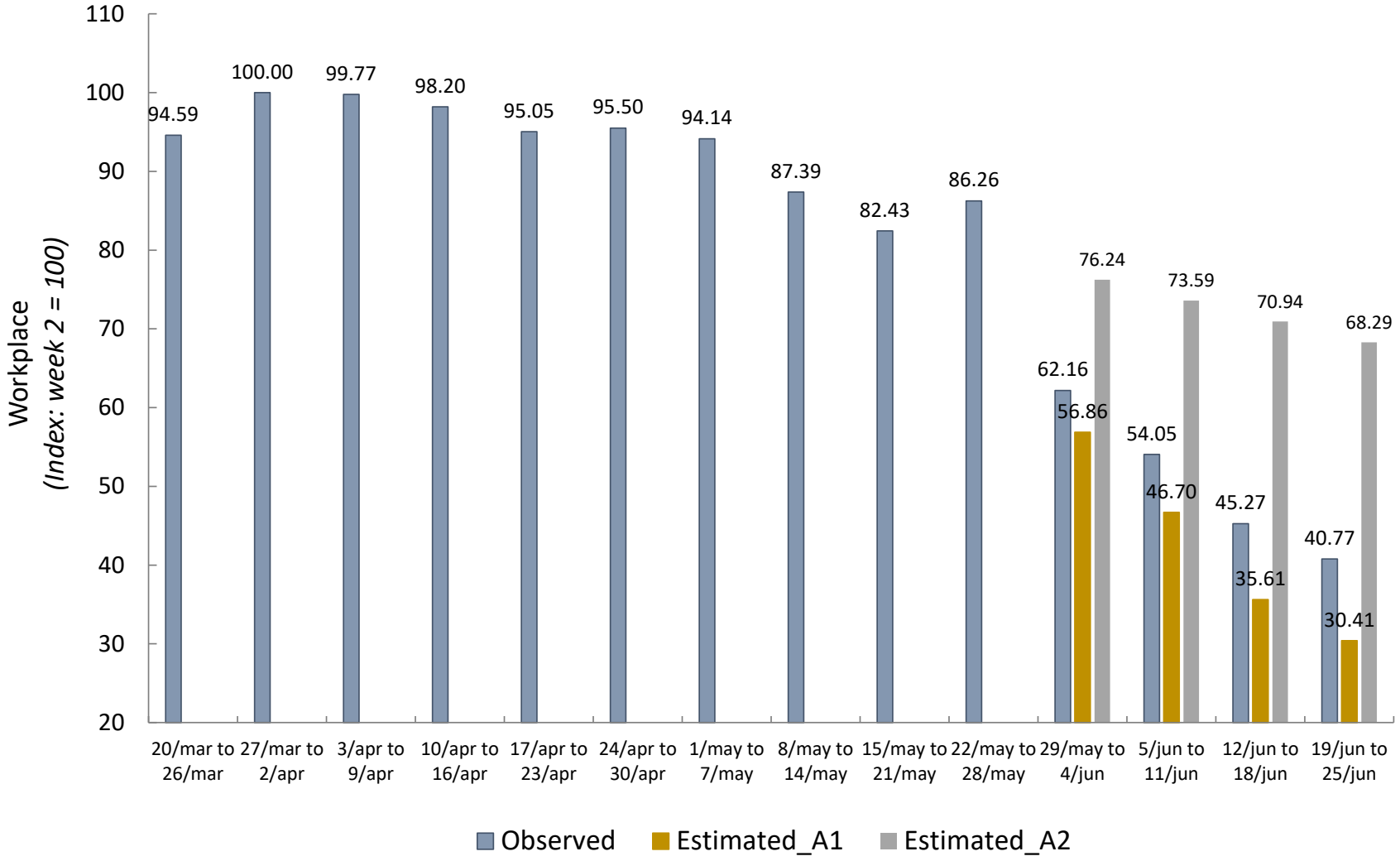


COVID-19 Community Mobility Reports - Google



https://www.google.com/covid19/mobility/

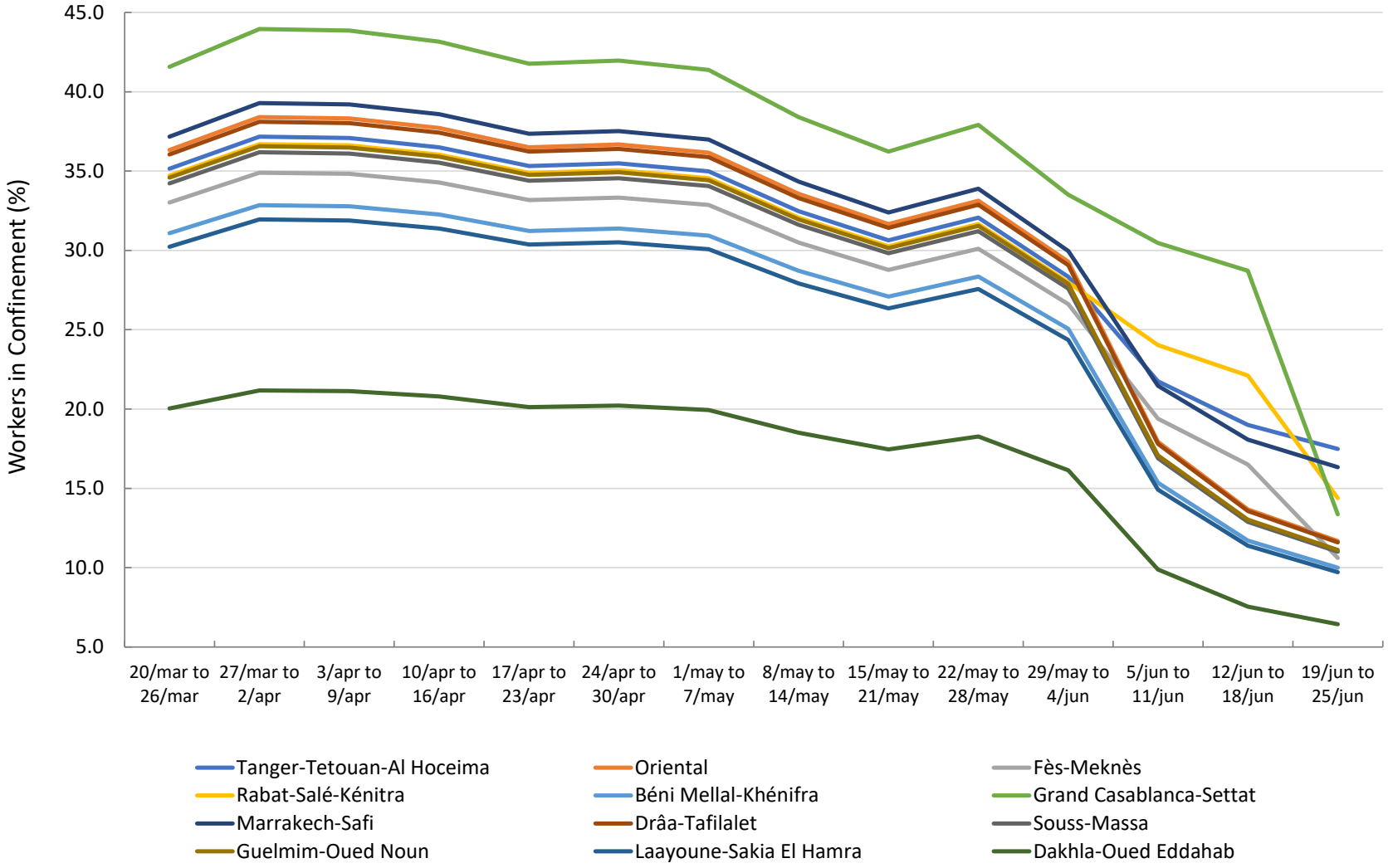
COVID-19 Community Mobility Reports - Google



Population in confinement: Area 2 (%)

Region	*Area from June 10th to June 24th*	*Area starting from June 25th*
Tanger-Tetouan-Al Hoceima	43.9%	43.9%
Oriental	0.0%	0.0%
Fès-Meknès	33.0%	0.0%
Rabat-Salé-Kénitra	69.8%	23.2%
Béni Mellal-Khénifra	0.0%	0.0%
Grand Casablanca-Settat	84.2%	0.0%
Marrakech-Safi	29.4%	29.4%
Drâa-Tafilalet	0.0%	0.0%
Souss-Massa	0.0%	0.0%
Guelmim-Oued Noun	0.0%	0.0%
Laayoune-Sakia El Hamra	0.0%	0.0%
Eddakhla-Oued Eddahab	0.0%	0.0%

Workers in confinement: Area 2 (%)



Estimates of the number of workers in confinement

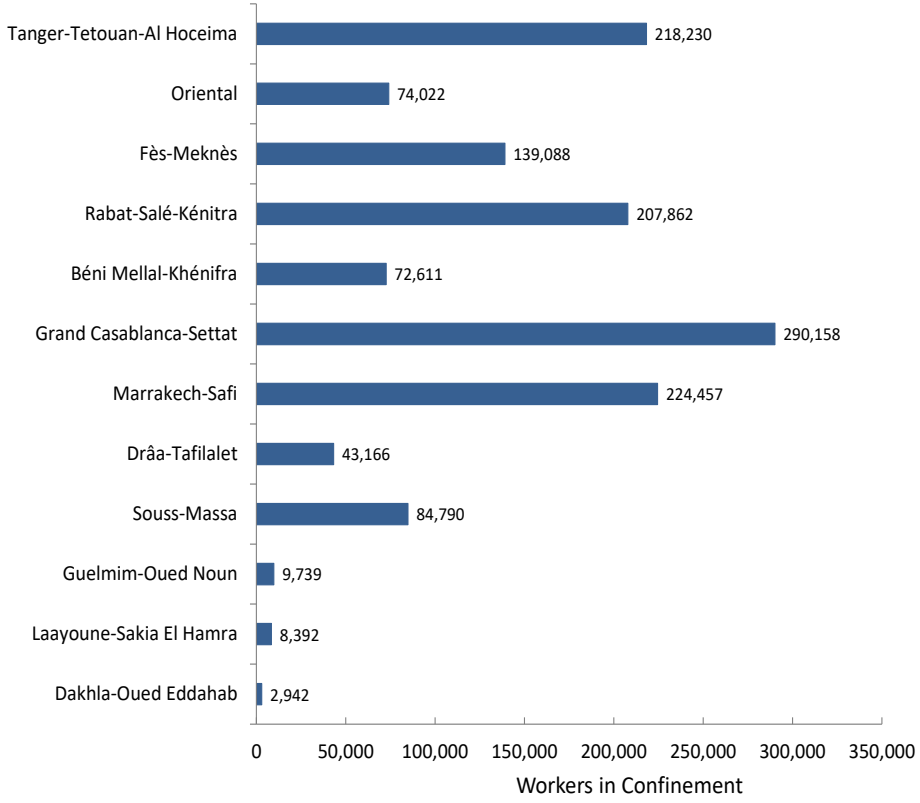
Morocco: 10.2 millions of workers

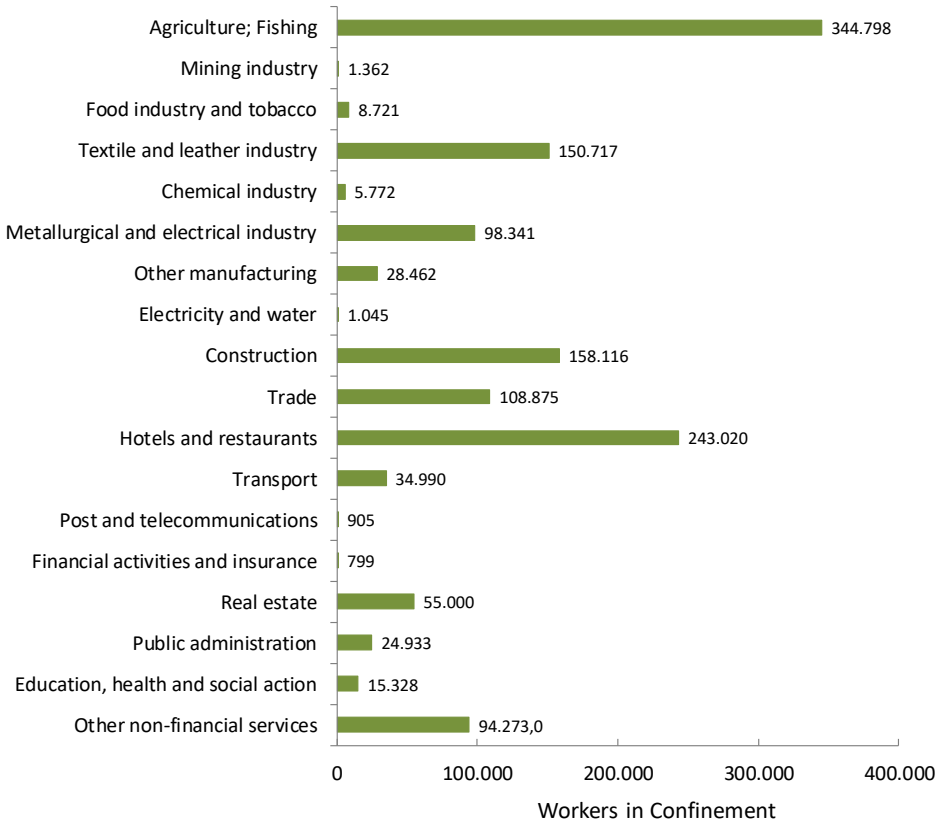
- Formal: 6.0 millions (58.8% of total)
- Informal: 4.2 millions (41.2% of total)

Workers in confinement: week 14 (june 19 to june 25)

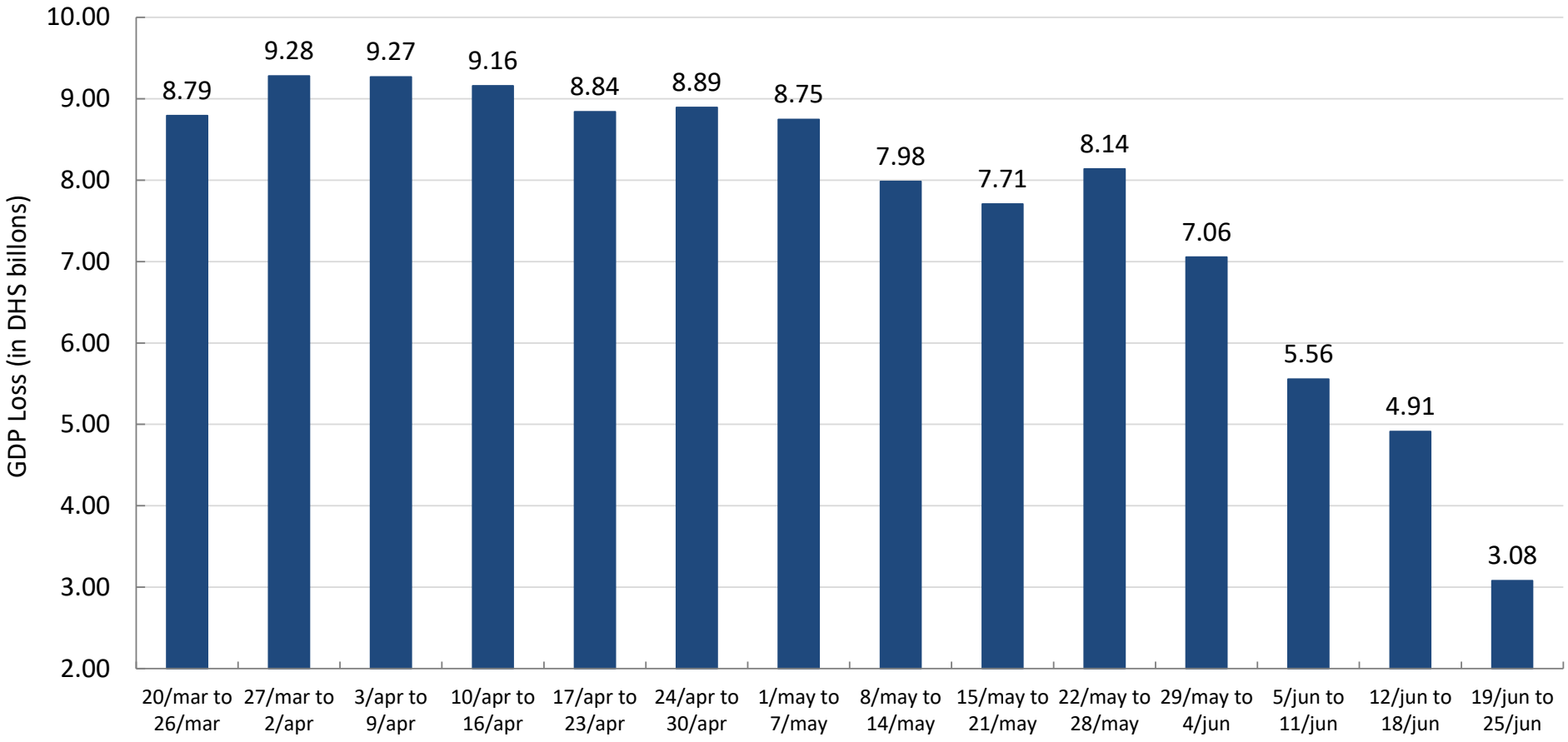
- 1.4 million (13.4% of total) workers in confinement
  - Formal: 0.8 million
  - Informal: 0.6 million

Estimates of the number of workers in confinement Week 14: June 19 to June 25

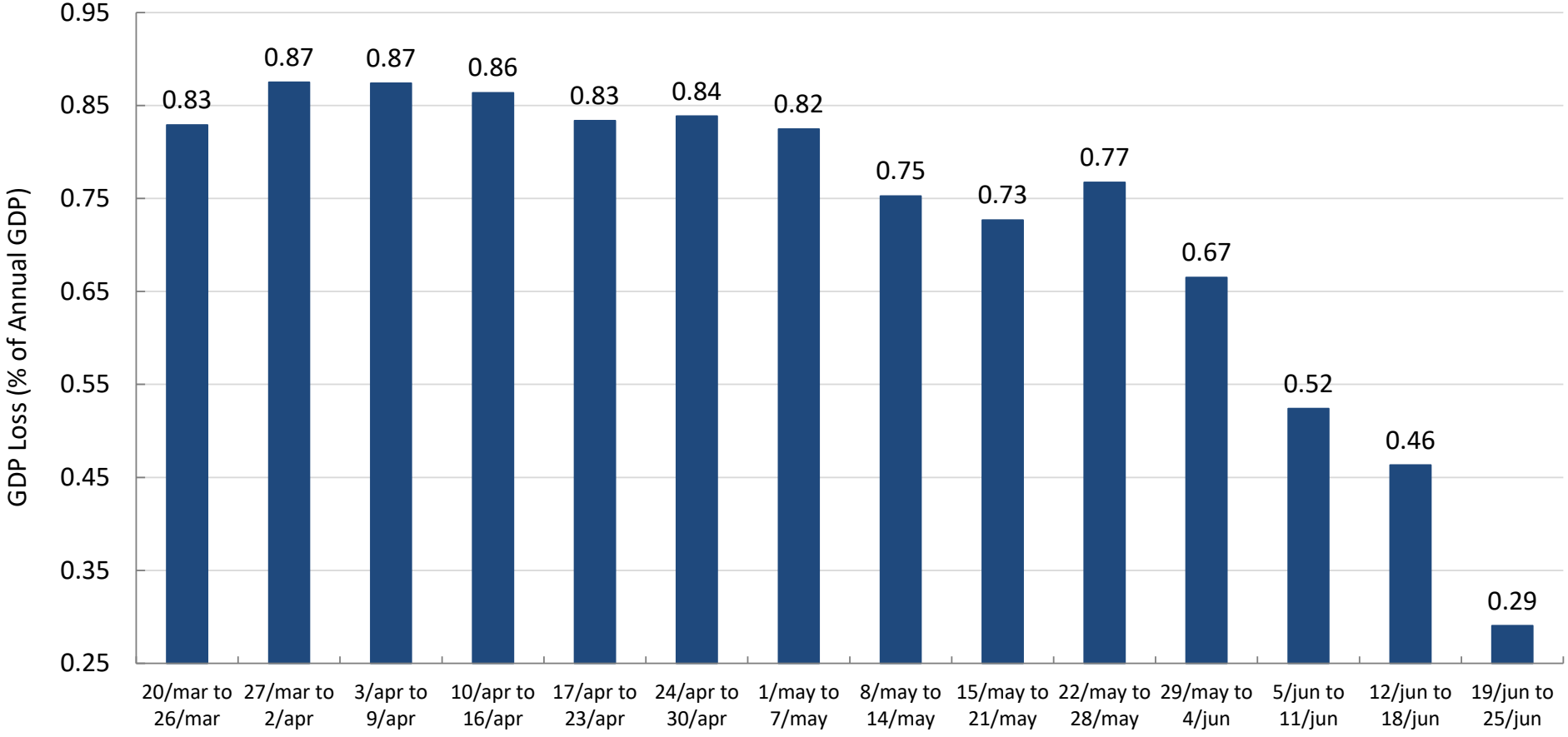




Economic impact: Weekly GDP Loss (in DHS billions)



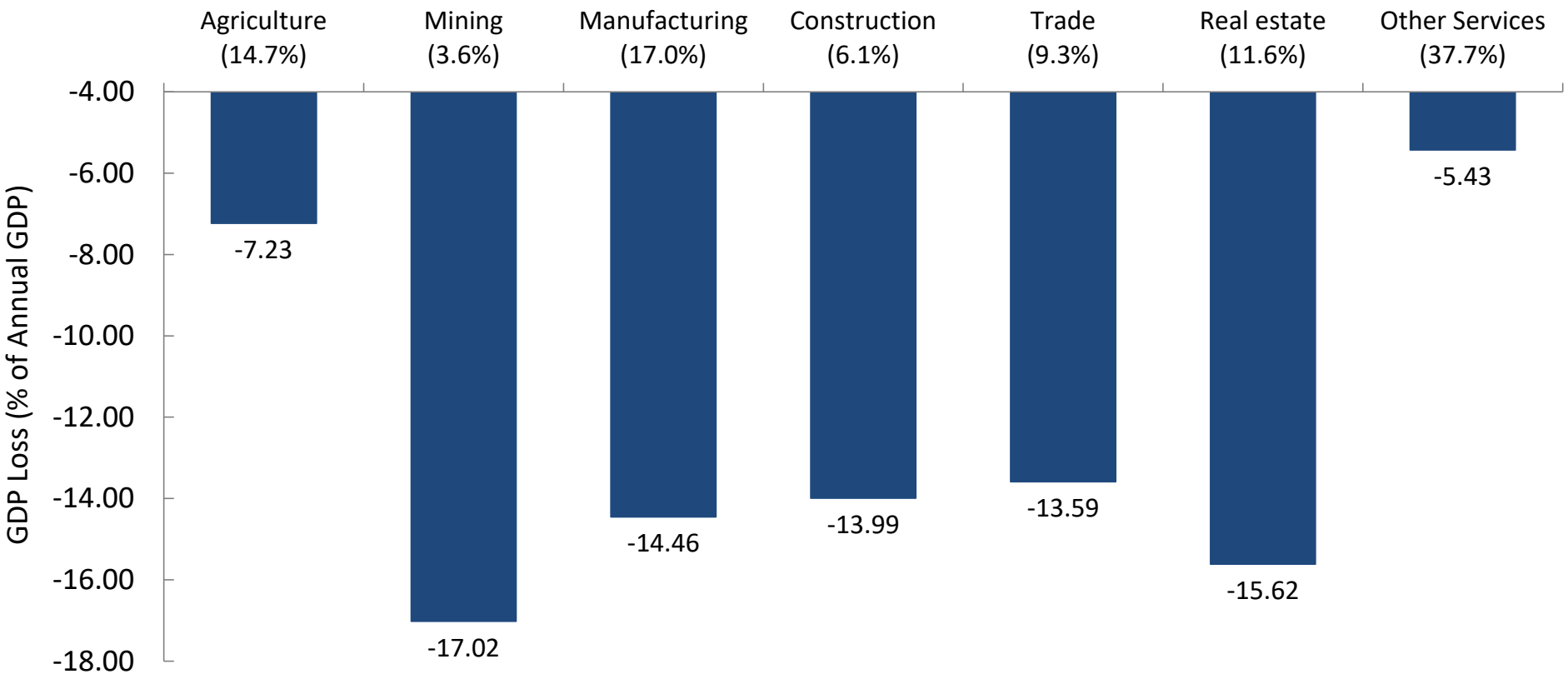
Economic impact: Weekly GDP Loss (in %)



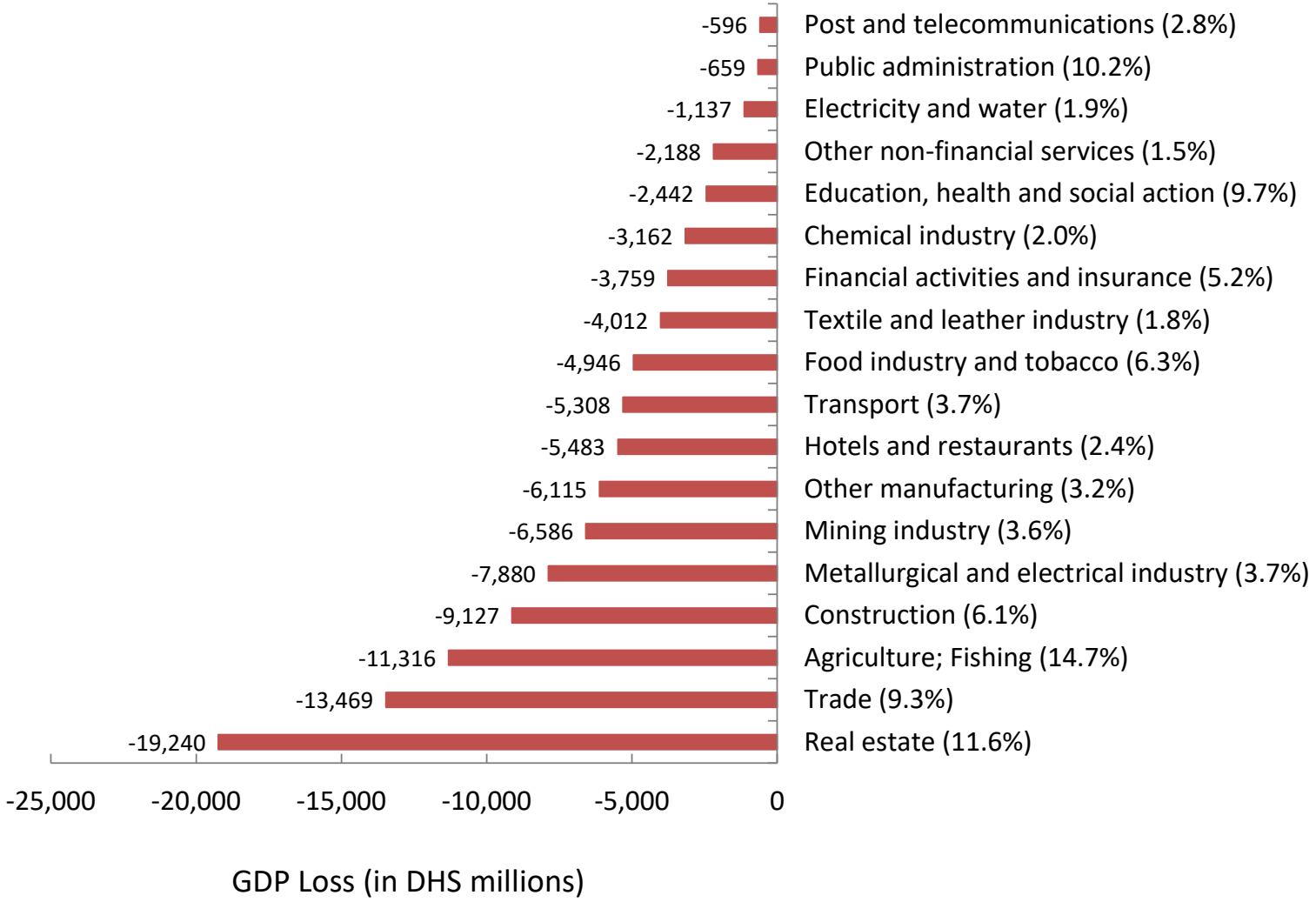
Economic impact: GDP Loss
Week 1-14: March 20 to June 25

Sector	*R1* *Tanger-Tetouan-Al*	*R2* *Oriental*	*R3* *Fès-Meknès*	*R4* *Rabat-Salé-Kénitra*	*R5* *Béni Mellal-Khénifra*	*R6* *Grand Casablanca-Settat*	*R7* *Marrakech-Safi*	*R8* *Drâa-Tafilalet*	*R9* *Souss-Massa*	*R10* *Guelmim-Oued Noun*	*R11* *Laayoune-Sakia El Hamra*	*R12* *Dakhla-Oued Eddahab*	***Morocco***	***% of sectorial GDP***
Agriculture; Fishing	-761	-805	-1,815	-1,307	-1,448	-1,537	-1,548	-629	-1,042	-198	-73	-153	**-11,316**	**-7.23**
Mining industry	0	-230	-39	-157	-2,859	-14	-2,088	-668	-6	0	-525	0	**-6,586**	**-17.02**
Food industry and tobacco	-248	-85	-468	-272	-175	-2,514	-309	-18	-711	-36	-79	-30	**-4,946**	**-7.37**
Textile and leather industry	-849	-32	-445	-409	-2	-2,184	-88	0	-3	0	0	0	**-4,012**	**-20.79**
Chemical industry	-92	-32	-107	-189	-10	-2,353	-268	-2	-53	0	-55	0	**-3,162**	**-15.15**
Metallurgical and electrical industry	-1,983	-346	-355	-665	-44	-4,340	-50	-4	-90	0	-3	0	**-7,880**	**-20.16**
Other manufacturing	-646	-120	-366	-418	-77	-3,757	-361	-9	-271	-12	-70	-9	**-6,115**	**-17.86**
Electricity and water	-130	-65	-106	-252	-50	-288	-125	-19	-78	-8	-15	-1	**-1,137**	**-5.74**
Construction	-1,100	-853	-795	-1,196	-579	-1,900	-1,328	-518	-540	-85	-209	-21	**-9,127**	**-13.99**
Trade	-1,362	-1,332	-1,463	-1,756	-766	-3,838	-1,474	-256	-898	-157	-135	-34	**-13,469**	**-13.59**
Hotels and restaurants	-389	-155	-343	-227	-47	-670	-2,011	-150	-1,453	-11	-13	-13	**-5,483**	**-21.53**
Transport	-438	-448	-552	-814	-254	-1,607	-529	-133	-360	-84	-69	-19	**-5,308**	**-13.40**
Post and telecommunications	-38	-83	-12	-44	-2	-331	-30	-11	-26	-8	-10	-1	**-596**	**-2.00**
Financial activities and insurance	-170	-160	-171	-738	-77	-1,934	-282	-32	-164	-13	-14	-2	**-3,759**	**-6.78**
Real estate	-957	-946	-1,148	-4,102	-482	-8,631	-1,610	-233	-902	-104	-98	-27	**-19,240**	**-15.62**
Public administration	-69	-35	-44	3	-56	-157	-120	-22	-45	-30	-75	-10	**-659**	**-0.61**
Education, health and social action	-167	-181	-314	-391	-139	-652	-256	-61	-196	-32	-38	-15	**-2,442**	**-2.39**
Other non-financial services	-188	-133	-177	-456	-93	-641	-301	-38	-127	-16	-15	-5	**-2,188**	**-13.52**
Total	**-9,588**	**-6,042**	**-8,719**	**-13,390**	**-7,161**	**-37,351**	**-12,777**	**-2,804**	**-6,963**	**-795**	**-1,497**	**-339**	**-107,424**	
% of regional GDP	**-11.36**	**-9.00**	**-8.33**	**-8.41**	**-9.60**	**-11.96**	**-10.81**	**-9.05**	**-9.77**	**-5.79**	**-8.13**	**-5.92**	**-10.13**	

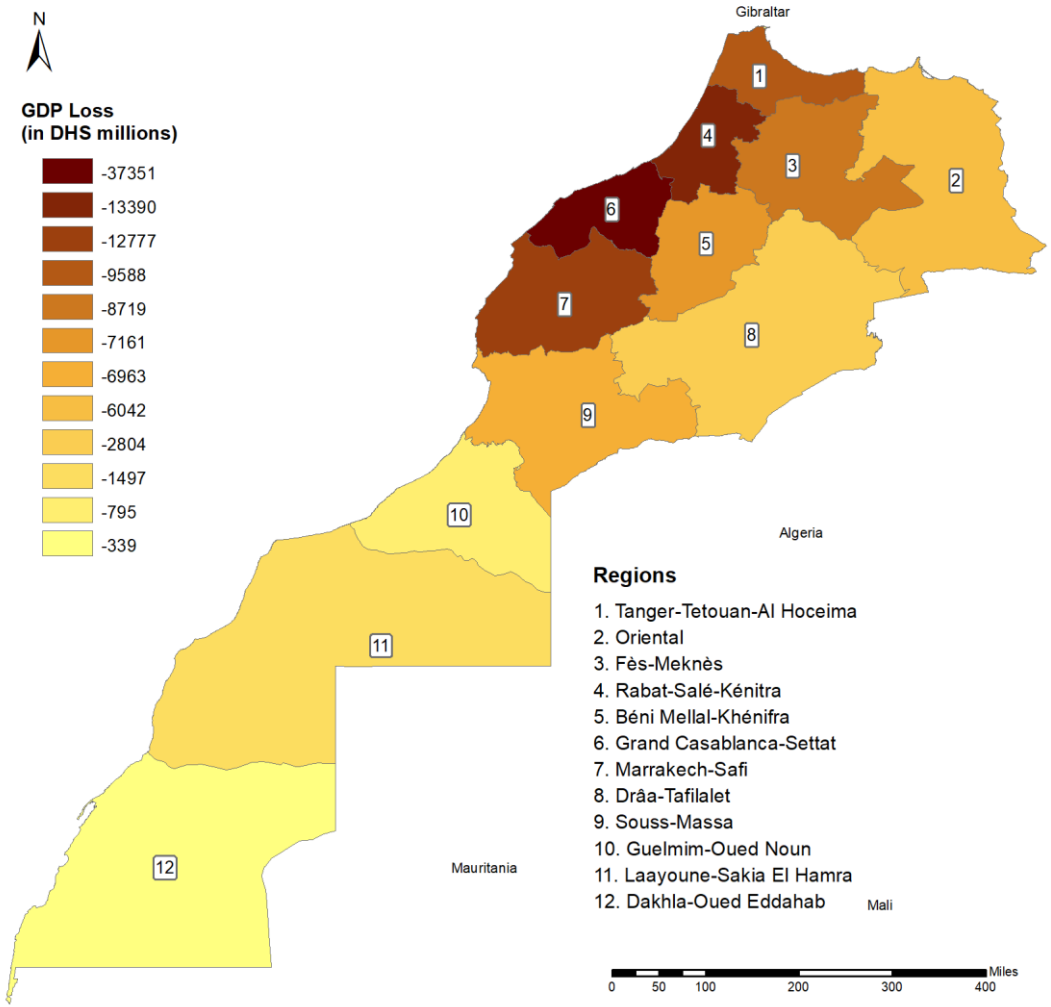
Economic impact: GDP Loss
Week 1-14: March 20 to June 25



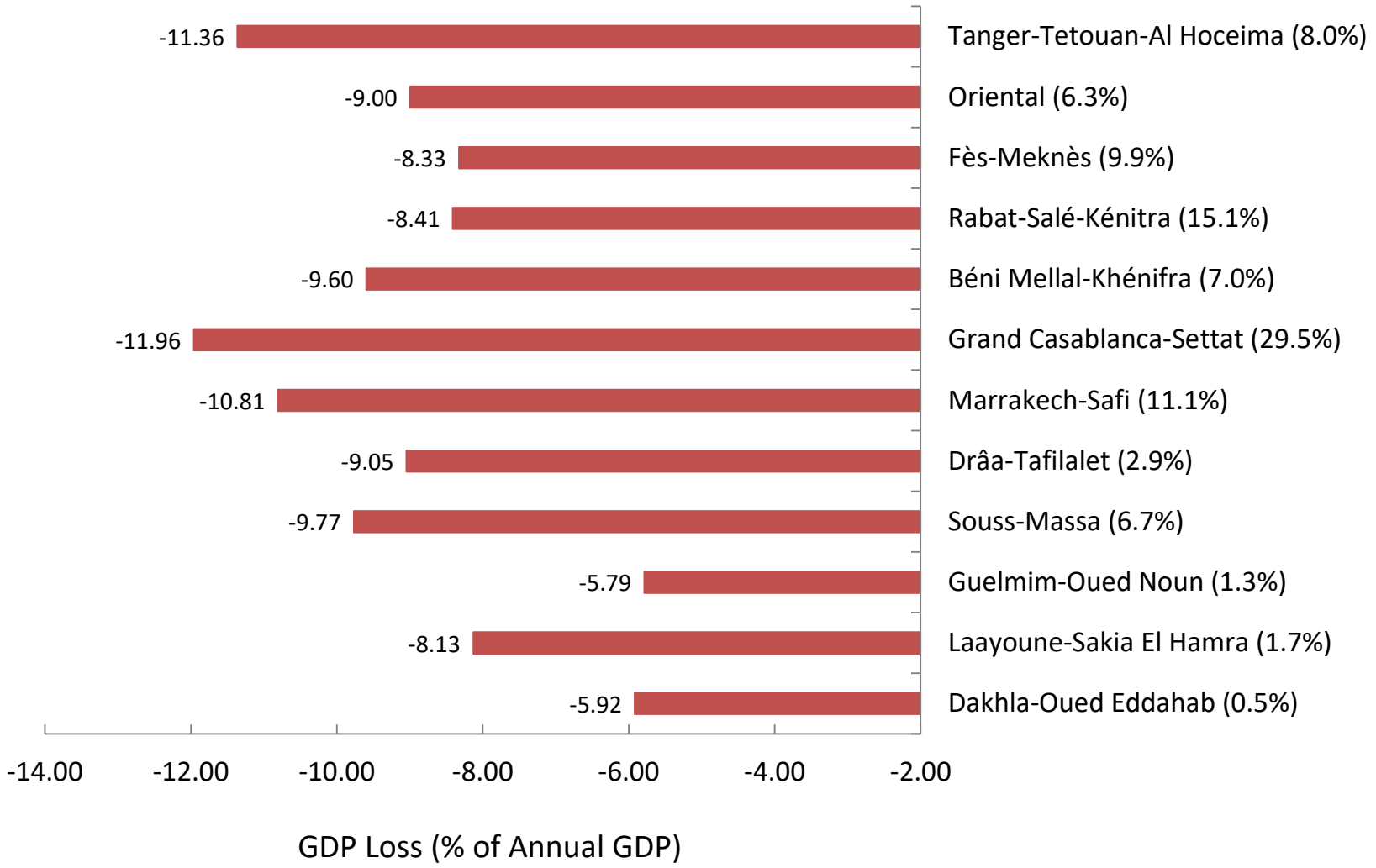
Economic impact: GDP Loss
Week 1-14: March 20 to June 25



Economic impact: GDP Loss
Week 1-14: March 20 to June 25



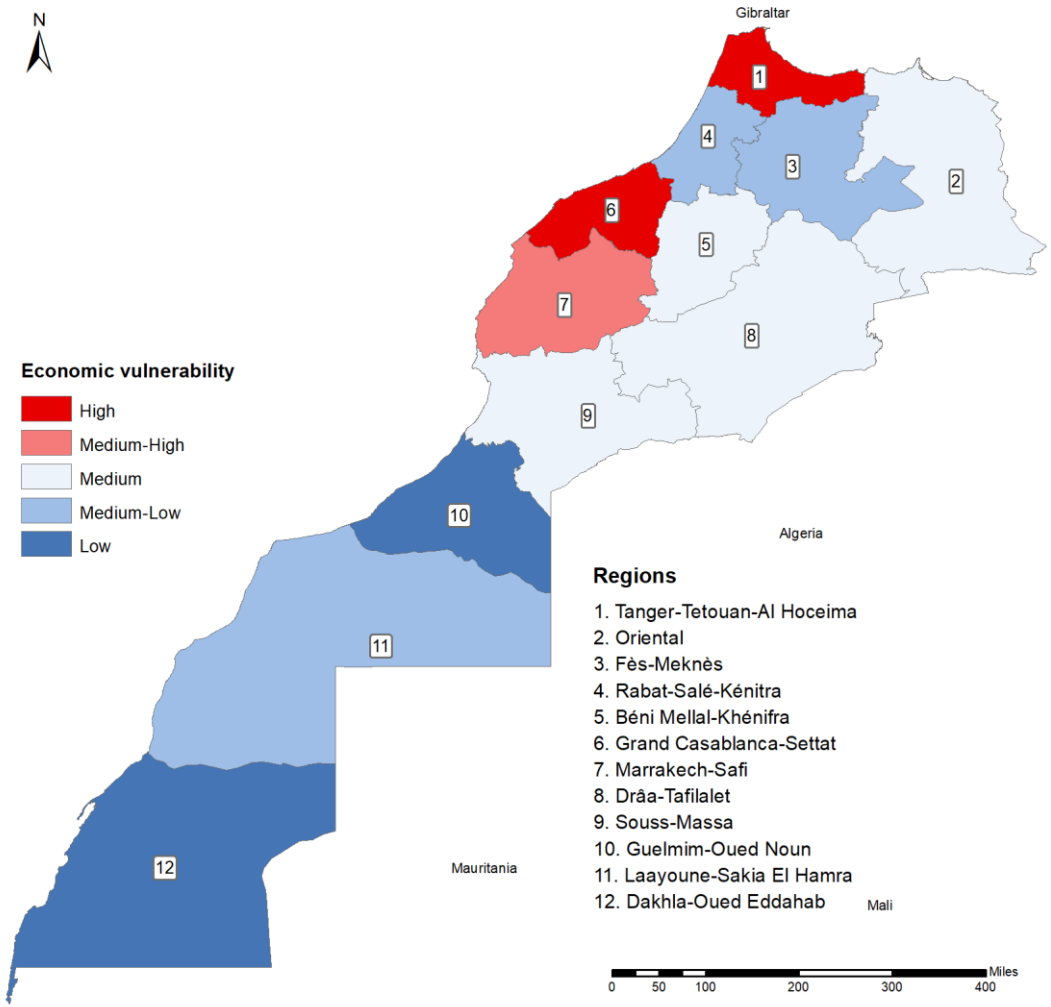
Economic impact: GDP Loss
Week 1-14: March 20 to June 25



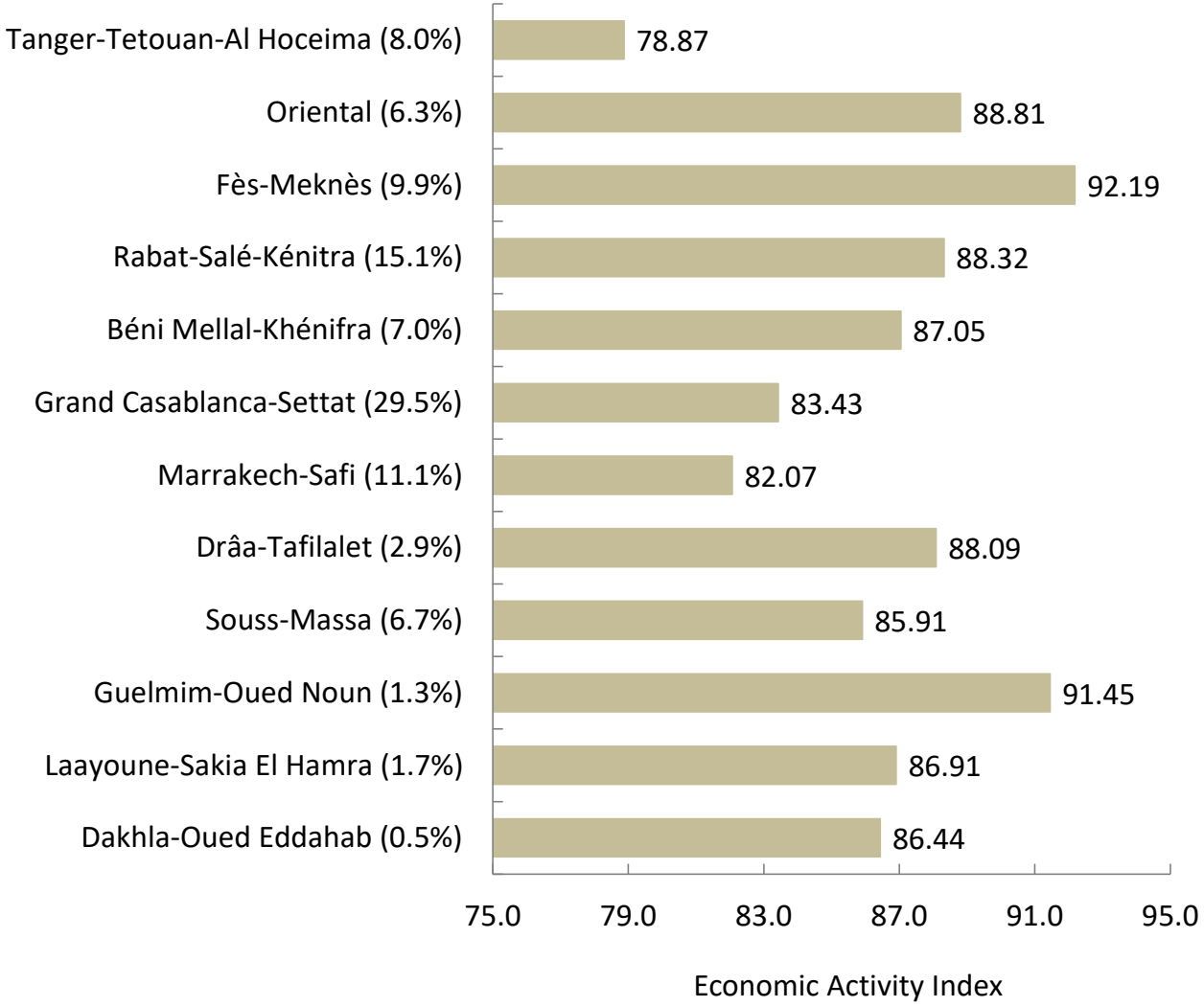
Economic vulnerability

Rank	*Region*	*Index*	*Vulnerability*
1	Hotels and restaurants	1.000	High
2	Textile and leather industry	0.965	High
3	Metallurgical and electrical industry	0.934	High
4	Other manufacturing	0.824	Medium-High
5	Mining industry	0.784	Medium-High
6	Real estate	0.717	Medium
7	Chemical industry	0.695	Medium
8	Construction	0.640	Medium
9	Trade	0.620	Medium
10	Other non-financial services	0.617	Medium
11	Transport	0.611	Medium
12	Food industry and tobacco	0.323	Medium-Low
13	Agriculture; Fishing	0.317	Medium-Low
14	Financial activities and insurance	0.295	Medium-Low
15	Electricity and water	0.245	Low
16	Education, health and social action	0.085	Low
17	Post and telecommunications	0.067	Low
18	Public administration	0.000	Low

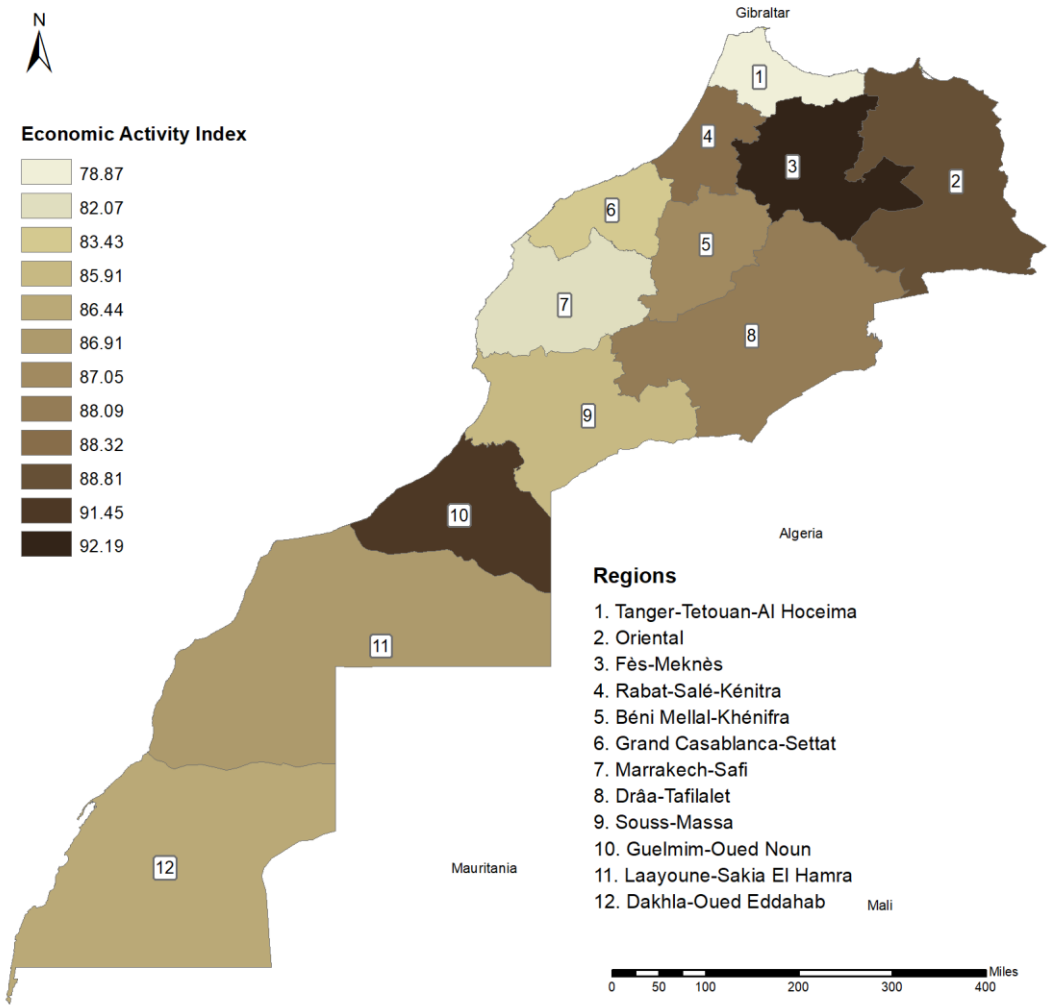
Economic vulnerability



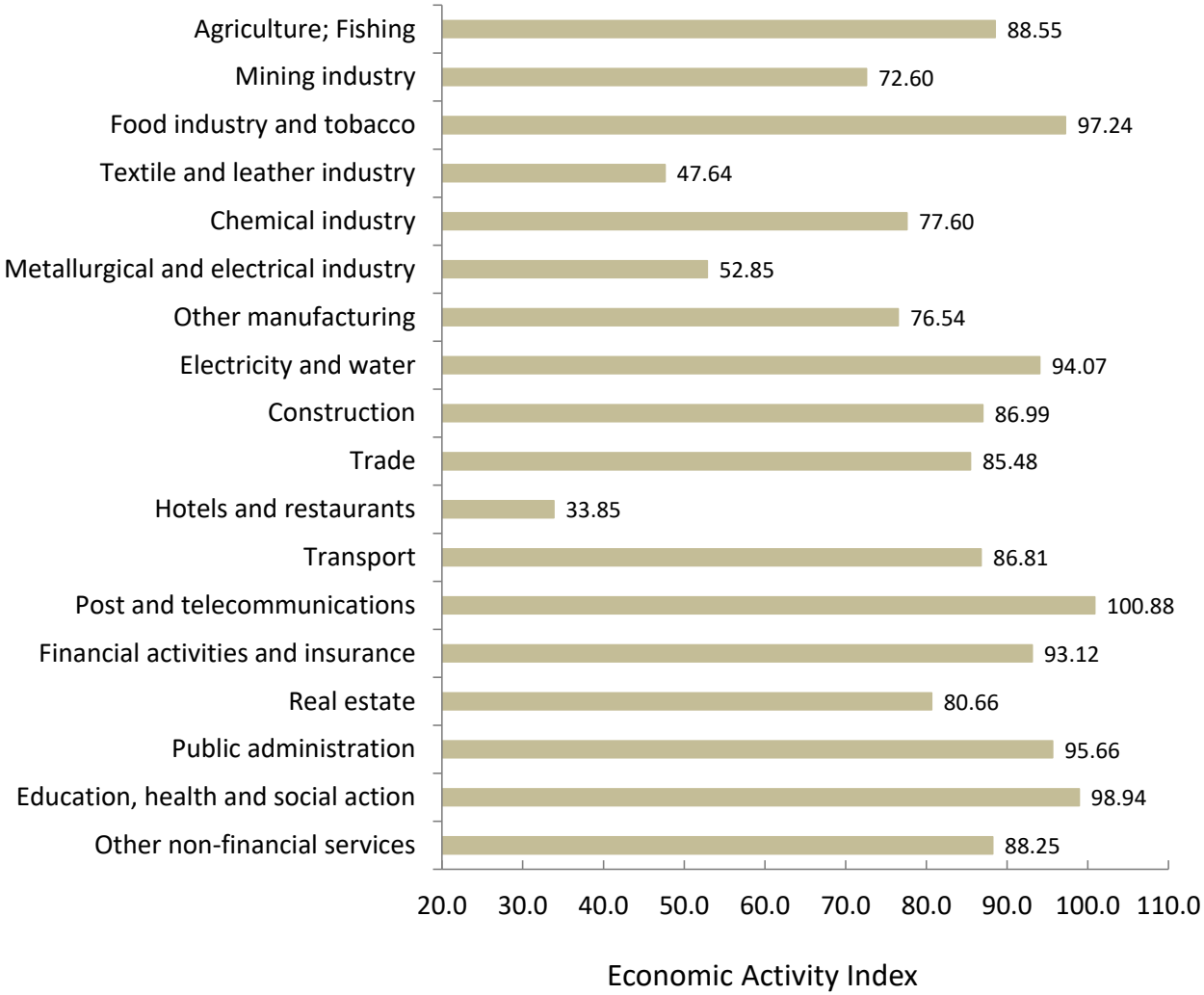
Economic Activity Index (2019 weekly average = 100)
Week 14: June 19 to June 25



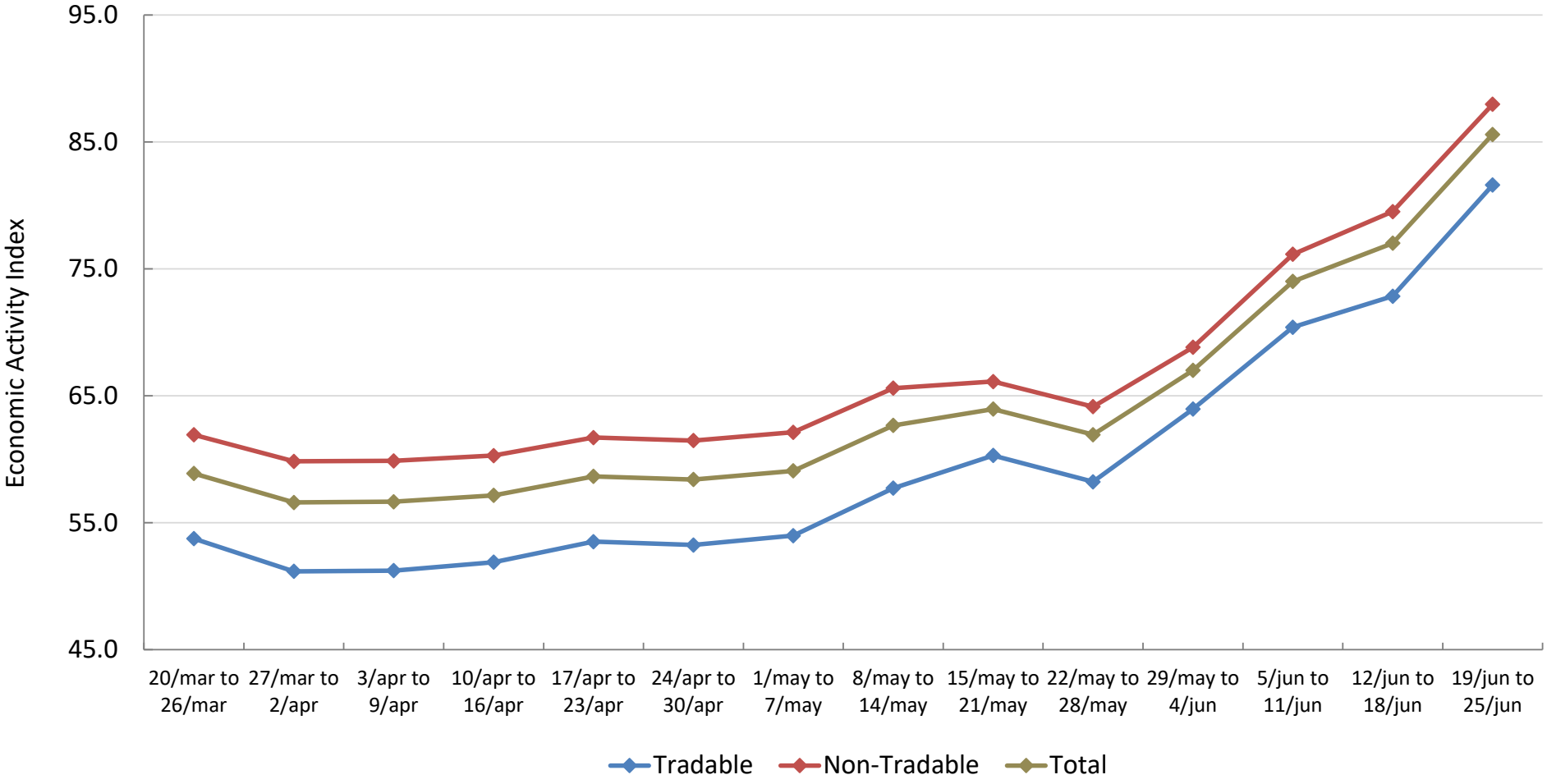
Economic Activity Index (2019 weekly average = 100)
Week 14: June 19 to June 25



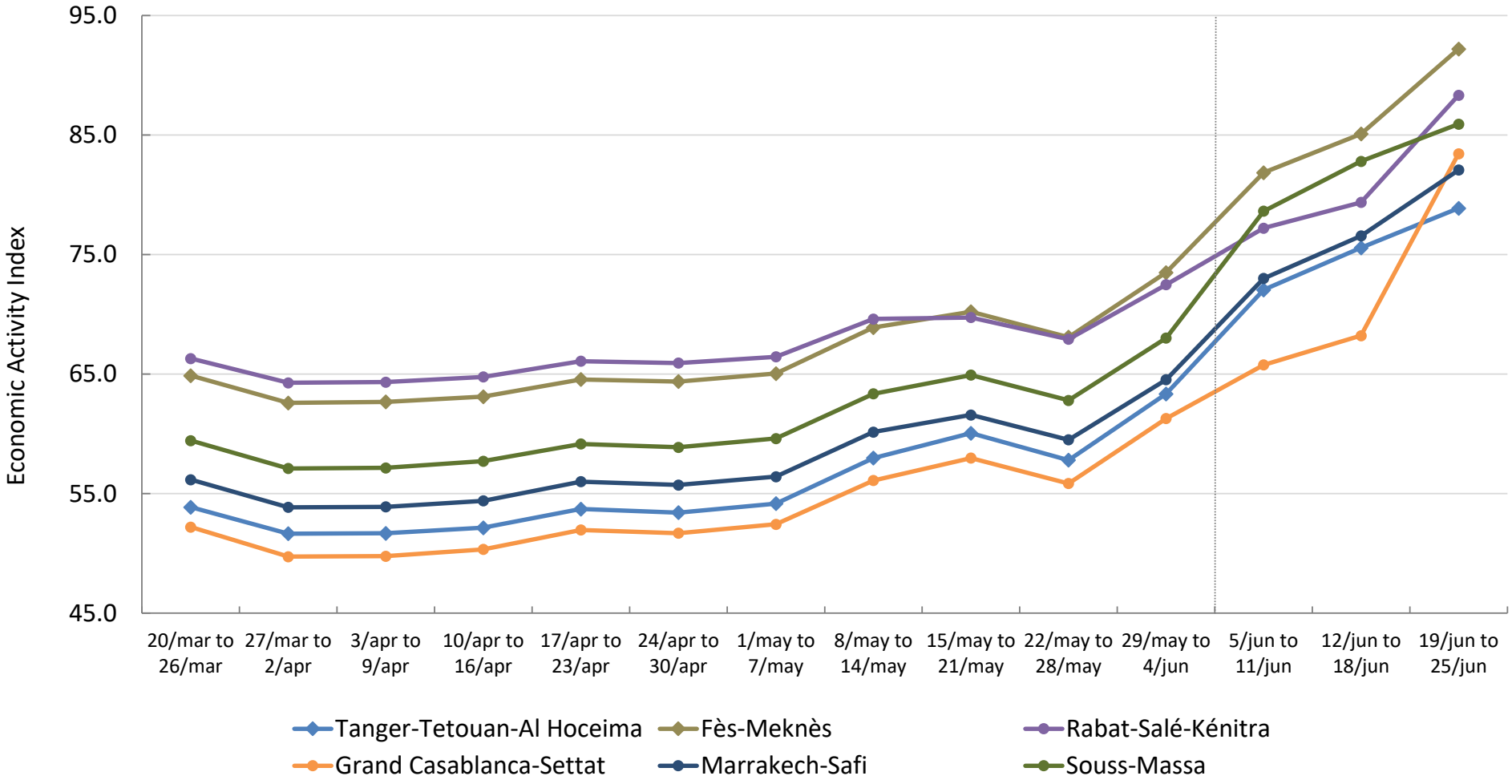
Economic Activity Index (2019 weekly average = 100)
Week 14: June 19 to June 25



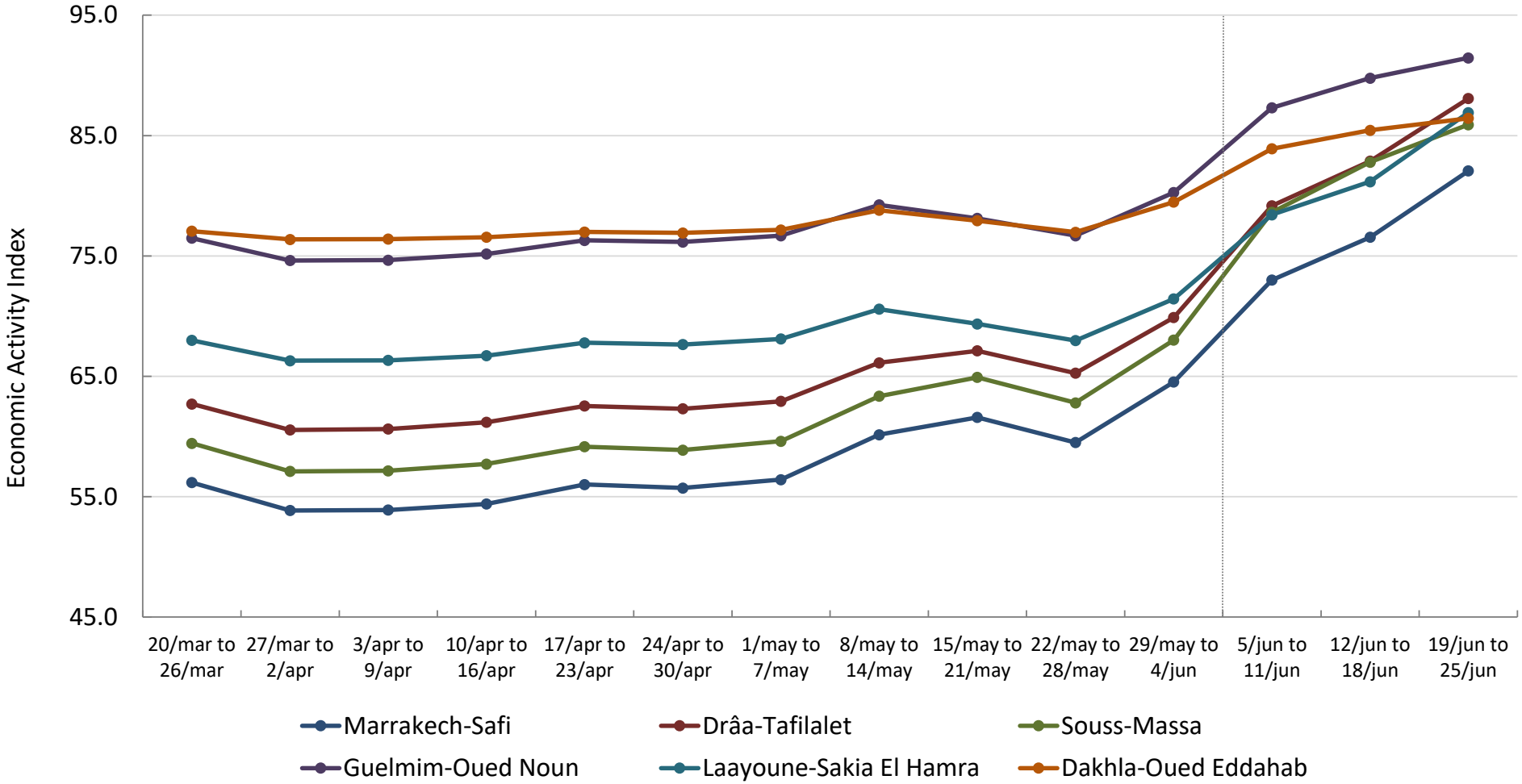
Economic Activity Index: Morocco (2019 weekly average = 100)



Economic Activity Index: Regions (2019 weekly average = 100)



Economic Activity Index: Regions (2019 weekly average = 100)



Expenses of the COVID-19 fund

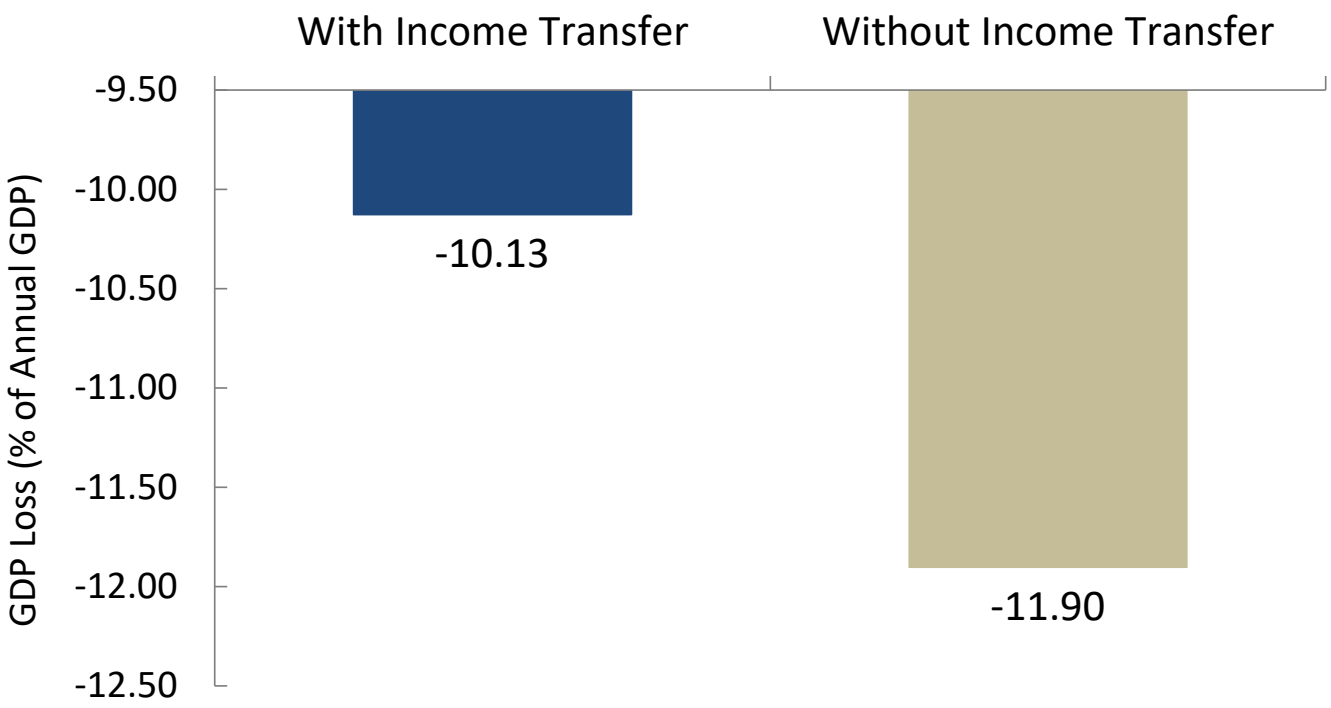
Different expenses to end of June:

- Transfer to employees: 23.0 (in DHS billions)
  - Formal: 12.0 (in DHS billions)
    - *Direct transfer to formal employees: 7.0 (in DHS billions)*
    - *Loan guarantee: 5.0 (in DHS billions)*
  - Informal: 11.0 (in DHS billions)
- Health equipment purchase: 2.0 (in DHS billions)

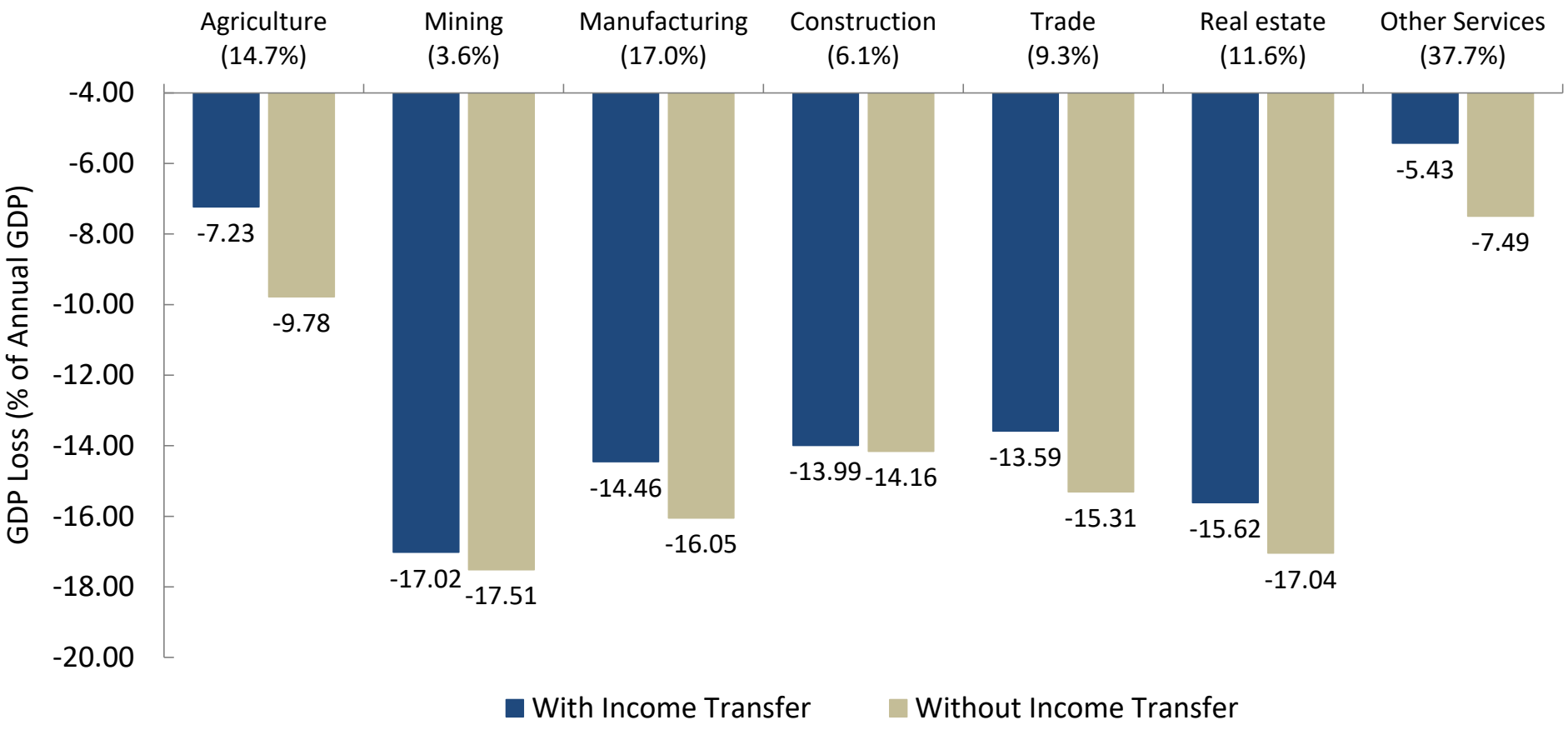
Expenses of the COVID-19 fund (in DHS millions)

Region	*Transfer to formal employees*	*Transfer to informal employees*	*Health equipment purchase*
Tanger-Tetouan-Al Hoceima	1,249	1,610	100
Oriental	721	703	127
Fès-Meknès	1,445	1,516	197
Rabat-Salé-Kénitra	1,812	1,385	609
Béni Mellal-Khénifra	738	920	104
Grand Casablanca-Settat	2,744	2,046	302
Marrakech-Safi	1,524	1,590	187
Drâa-Tafilalet	421	416	68
Souss-Massa	1,042	639	90
Guelmim-Oued Noun	106	89	80
Laayoune-Sakia El Hamra	125	61	112
Dakhla-Oued Eddahab	72	24	26
Marocco	**12,000**	**11,000**	**2,000**

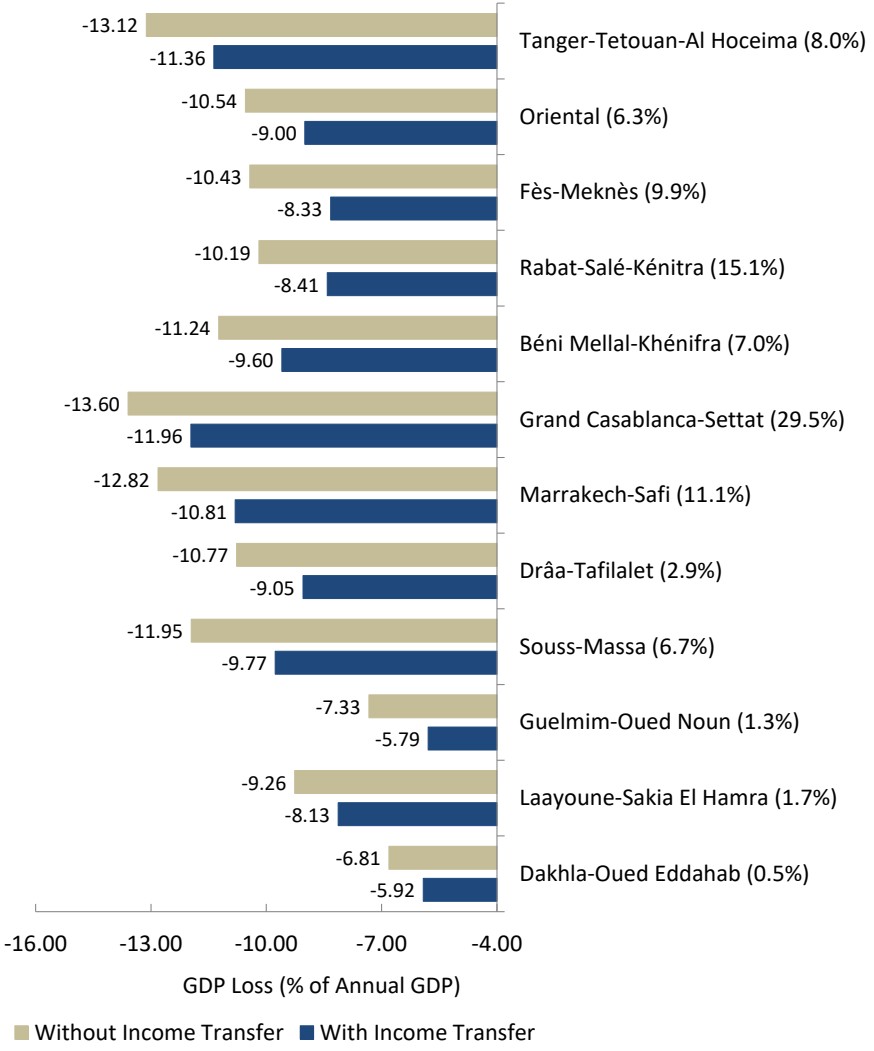
Economic impact: GDP Loss
Week 1-14: March 20 to June 25



Economic impact: GDP Loss
Week 1-14: March 20 to June 25



Economic impact: GDP Loss
Week 1-14: March 20 to June 25



Economic impact: Transfers
Week 1-14: March 20 to June 25

	Region	GDP (in DHS millions)	GDP Loss (in DHS millions)	Transfers (in DHS millions)	A GDP (%)	B GDP Loss (%)	C Transfers (%)	(C) / (A)	(C) / (B)
R1	Tanger-Tetouan-Al Hoceima	84,369	9,588	2,959	7.95%	8.93%	11.83%	1.49	1.33
R2	Oriental	67,150	6,042	1,551	6.33%	5.62%	6.20%	0.98	1.10
R3	Fès-Meknès	104,724	8,719	3,158	9.87%	8.12%	12.63%	1.28	1.56
R4	Rabat-Salé-Kénitra	159,169	13,390	3,806	15.01%	12.46%	15.22%	1.01	1.22
R5	Béni Mellal-Khénifra	74,614	7,161	1,761	7.03%	6.67%	7.05%	1.00	1.06
R6	Grand Casablanca-Settat	312,290	37,351	5,093	29.44%	34.77%	20.37%	0.69	0.59
R7	Marrakech-Safi	118,208	12,777	3,301	11.14%	11.89%	13.20%	1.18	1.11
R8	Drâa-Tafilalet	30,996	2,804	904	2.92%	2.61%	3.62%	1.24	1.39
R9	Souss-Massa	71,277	6,963	1,772	6.72%	6.48%	7.09%	1.05	1.09
R10	Guelmim-Oued Noun	13,736	795	275	1.30%	0.74%	1.10%	0.85	1.49
R11	Laayoune-Sakia El Hamra	18,413	1,497	298	1.74%	1.39%	1.19%	0.69	0.85
R12	Dakhla-Oued Eddahab	5,728	339	122	0.54%	0.32%	0.49%	0.91	1.55

Morocco	**1,060,672**	**107,424**	**25,000**

Driving forces of GDP decline: Morocco
Week 14: June 19 to June 25

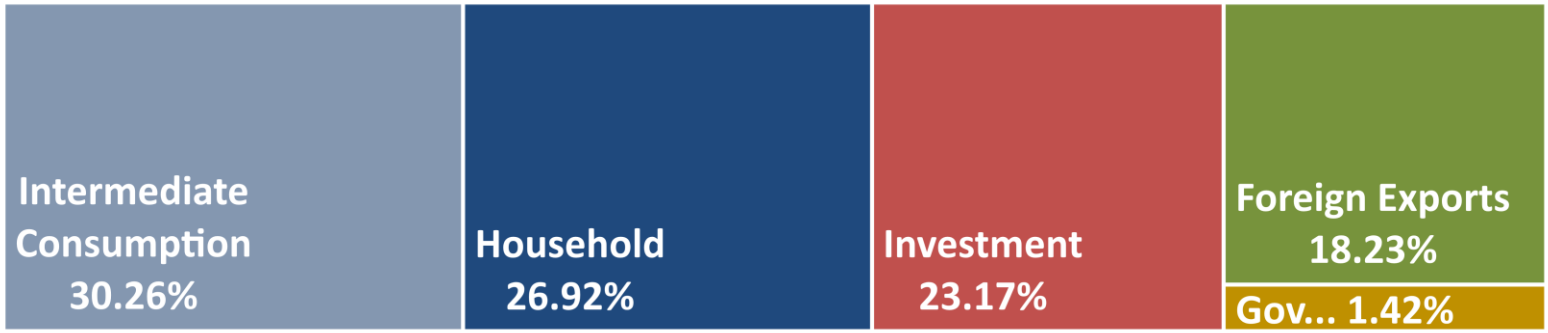
	Economic Loss - Week (in DHS millions)	*Economic Loss - Week (%)*	*Economic Loss (%)*
Intermediate Consumption	1,220	0.12	39.59
Investment Demand	586	0.06	19.03
Household Demand	108	0.01	3.50
Government Demand	151	0.01	4.91
Foreign Exports	1,016	0.10	32.97
Total	***3,081***	***0.29***	***100.00***

Driving forces of GDP decline: Regions
Week 14: June 19 to June 25

	Region	*Intermediate Consumption*	*Investment Demand*	*Household Demand*	*Government Demand*	*Foreign Exports*	***Total***
R1	Tanger-Tetouan-Al Hoceima	27.89	20.04	6.82	2.37	42.89	**100.00**
R2	Oriental	37.36	26.90	0.80	5.47	29.46	**100.00**
R3	Fès-Meknès	56.05	18.69	-19.64	10.12	34.78	**100.00**
R4	Rabat-Salé-Kénitra	43.96	24.67	-3.44	8.15	26.67	**100.00**
R5	Béni Mellal-Khénifra	43.23	11.43	-9.95	5.51	49.77	**100.00**
R6	Grand Casablanca-Settat	39.54	17.71	-0.87	2.80	40.81	**100.00**
R7	Marrakech-Safi	39.28	19.81	22.13	4.41	14.37	**100.00**
R8	Drâa-Tafilalet	43.19	23.12	6.48	6.57	20.64	**100.00**
R9	Souss-Massa	41.40	13.32	28.16	3.95	13.17	**100.00**
R10	Guelmim-Oued Noun	34.64	15.88	-2.60	22.13	29.95	**100.00**
R11	Laayoune-Sakia El Hamra	32.24	20.23	-2.19	17.71	32.01	**100.00**
R12	Dakhla-Oued Eddahab	8.61	5.64	6.51	9.97	69.28	**100.00**
	Morocco	**39.59**	**19.03**	**3.50**	**4.91**	**32.97**	**100.00**

Contribution of macroeconomic aggregates to GDP changes: Morocco

Week 1: March 20 to March 26



Week 14: June 19 to June 25

Thank you!

ehaddad@usp.br

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The University of São Paulo Regional and Urban Economics Lab

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